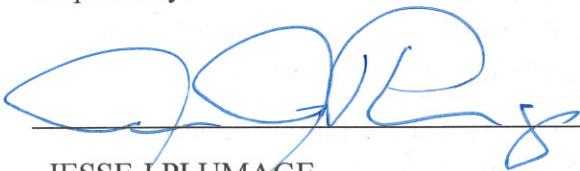


**South Fork Stillaguamish Project
Mt Baker-Snoqualmie National Forest**

TERRESTRIAL WILDLIFE BIOLOGICAL ASSESSMENT

Prepared by:



JESSE J PLUMAGE
Forest Wildlife Program Manager

April 9, 2018

SUMMARY OF EFFECTS AND DETERMINATIONS

The proposed South Fork Stillaguamish Project may affect, likely to adversely affect (LAA) the northern spotted owl and marbled murrelet due to limited, short-term, but potential harassment from project-associated noise disturbance from machinery. Other activities affecting these species include removal of spotted owl dispersal habitat, removal of primary constituent elements of northern spotted owl and marbled murrelet critical habitat, and the presence of smoke from prescribed burning of debris during the northern spotted owl and marbled murrelet nesting season. The proposed action may affect, but is not likely to adversely affect grizzly bear and gray wolf. Due to the above “may affect” determinations, consultation with the U.S. Fish and Wildlife Service is required.

1. Introduction

The purpose of this biological assessment is to portray the effects of the proposed project on federally-listed or proposed species, and determine the need for consultation with the U.S. Fish and Wildlife Service. Under Section 7 (c) of the Endangered Species Act, as amended in 1973, federal agencies are required to ensure that actions authorized, funded, or carried out by them are not likely to jeopardize the continued existence of proposed, threatened, and endangered species or result in the adverse modification of their critical habitats. This biological assessment will be used in the decision-making process for the South Fork Stillaguamish Project, and will become a part of the project’s analysis files. This document addresses terrestrial animal species only; federally-listed fish species will be addressed in a separate assessment.

Consultation History

- 13 November, 2015: On-site visit with Zach Radmer and Teal Waterstrat U.S. Fish and Wildlife Service, Lacey WA; Phyllis Reed (District Wildlife Biologist) and Jesse Plumage (Forest Wildlife Program Manager), Mt Baker-Snoqualmie National Forest.
- 25 November, 2015: Document from Zach Radmer, U.S. Fish and Wildlife Service recommendations on the silvicultural prescription, integrity of old forest edge, marbled murrelet potential nest trees in proposed harvest units, historic owl sites, and murrelet occupancy detections.
- 2 March, 2016: Document from Phyllis Reed, Forest Service response to recommendations from U.S Fish and Wildlife Service on the silvicultural prescription, integrity of old forest edge, marbled murrelet potential nest trees in proposed harvest units, historic owl sites, and murrelet occupancy detections.
- 3 June, 2016: On-site visit with Zach Radmer and Teal Waterstrat, U.S. Fish and Wildlife Service, Lacey WA; Phyllis Reed (District Wildlife Biologist) and Jesse Plumage (Forest

Wildlife Program Manager), Mt Baker-Snoqualmie National Forest. Reviewed proposed thinning treatments within 0.5 mile of historic owl and murrelet detections and criteria for high, moderate and low wildlife prioritization of stands for treatment. Review proposed treatments in older stands with more complexity stands with root rot and bark beetle. Discussed recommendations from U.S. Fish and Wildlife Service on the project design, and USFS response.

2. Project Location and Description

The legal location for the proposed South Fork Stillaguamish project area is: T29N R9E, R10E, and R11E; T29N, R8E, R9E, R10E, and R11E; and in T31N R8E. The project area is located in the South Fork Stillaguamish watershed in Snohomish County on the Darrington District, starting 10 miles to the east of Granite Falls, WA. It is in the north-central part of the Western Washington Cascades Province. The project area is shown in Figure 1 Project Vicinity Map.

The project planning area encompasses approximately 65,000 acres of National Forest System lands outside of wilderness in the South Fork Stillaguamish River drainage and lies entirely within a portion of the 110,108 acre Independence Late Successional Reserve (LSR) #116. The second-growth stands within this area were regenerated after clearcut harvesting that occurred from the early 1940's through the 1980's into the early 1990's. There are second growth stands on the slopes of Dickerman Mountain to Barlow Pass (upper drainage) that regenerated after fires started from railroad traffic between Everett and mining community of Monte Cristo. None of these mature second-growth fire stands (> 80 years of age) are part of the proposed thinning treatments.

Stand Structure

The proposed commercial thinning stands are in the stem exclusion stage of stand development (Oliver and Larson, 1996). Competition for growing space and resources (light, moisture, and soil nutrients) is high enough that some overstory trees are dying, and seedlings in the understory are unable to develop into mature trees. Relative density allows a quantifiable measure of stand

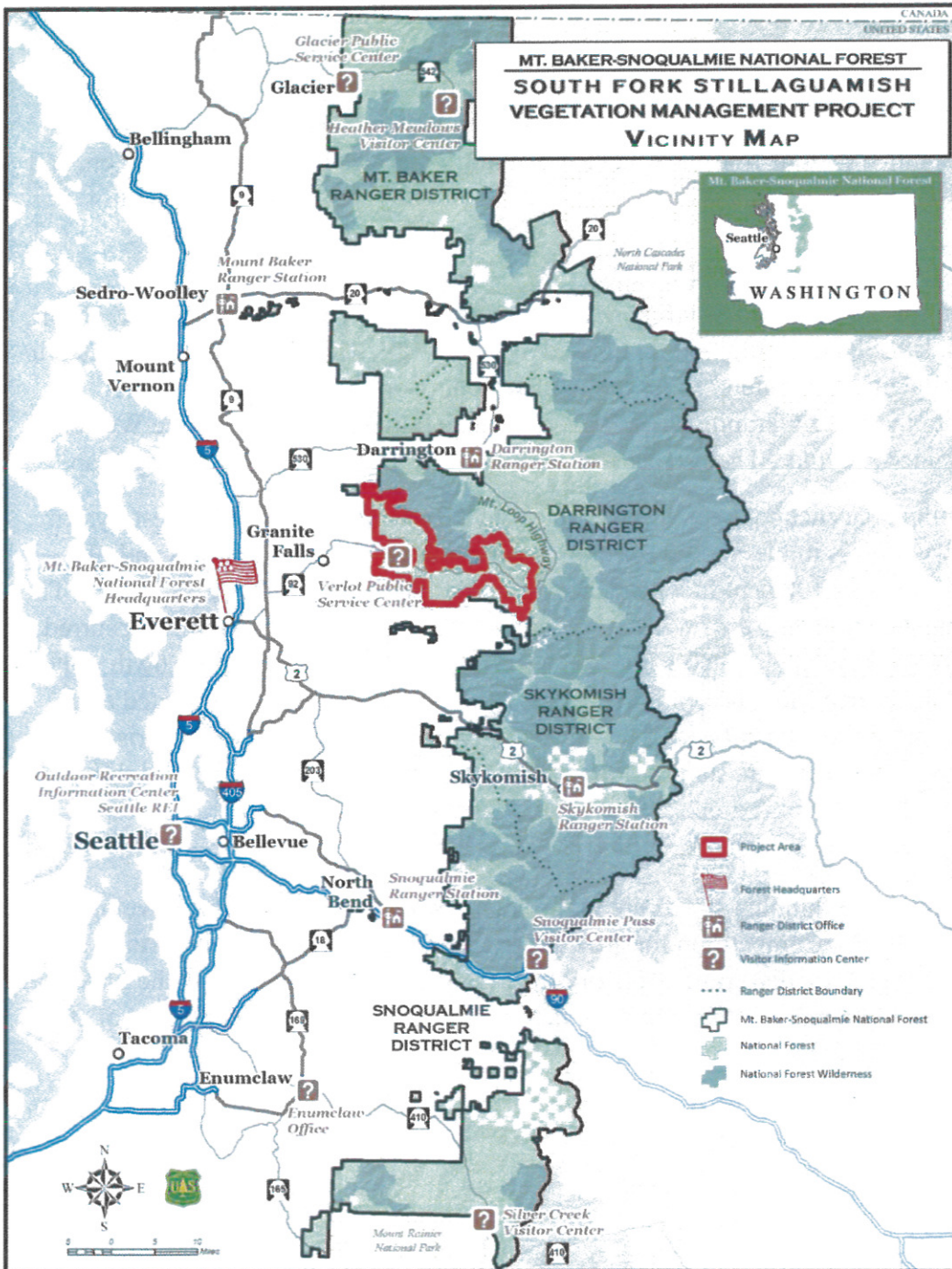


Figure 1. Project Vicinity Map

density relative to biological thresholds for suppression mortality and maximum density, similar to stand density index. A relative density below 50 avoids suppression mortality and excessive restriction of crown development for coastal Douglas-fir, while 100 approximates its biological maximum density (Curtis, 1982). The stands proposed for commercial thinning have an average relative density over 80, indicating that trees are dying because density is too high, and individual tree growth is below potential. Restriction of crown development prevents tree

branches from growing in length and diameter because they are crowded with branches from adjacent trees and receive limited light. While there are some benefits to restricting branch diameters for the purpose of high quality timber with fewer knots, the opposite applies for development of nesting platforms. Overcrowding in dense stands leads to suppression mortality, weakens trees, and decreases their resistance to damage by insects and disease (Oliver and Larson, 1996; Tappeiner, et al., 2007). Attributes of stands proposed for commercial thinning, as estimated from stand examination plots, are described in Table 2 and Table 3 below. Approximately 7% of the proposed stands are within the Silver Fir Zone.

The data in Tables 1 and 2 are a product of modeling with a small snag data set from stand exams which collected information for other objectives. The FSVeg program for projecting snag numbers may be limited by both the modeling program parameters and a small data set (only 2 stands for the montane forests type were sampled). Snag distribution is spotty and depending on the sampling strategy, may not be detected with the plots taken. The landscape scale view is provided by DecAid (Mellen et al. 2012) snag information for western conifer and montane forests with a larger database to project snags within old forest and second growth. This provides the background for the narrative and expectations for the landscape scale snag projections. Snag retention would contribute to the 50 to 80 percent tolerance level of snag density on the landscape (5th field watershed) scale as described in DecAID analysis advisor for species associated with snags and down wood (Mellen et al. 2012).

The thinning would capture some of the future snag and down wood that would be created from competition mortality as understory and intermediate trees are shaded out, and become snags over the next 50-100 years. There would be a reduction in potential snag and down wood biomass from the removal of these co-dominant and smaller diameter trees (less than 12 inches dbh). Snag retention would contribute to meeting the 30 to 50 percent tolerance level of snag densities for all cavity nesting species within the thinned stands of the 6th field analysis area. The proposed action would retain portions of stands with snags and exhibiting diversity in habitat such as the stand g59 which has heavy root rot pockets.

Table 1. Current average stand attributes by vegetation zone, for trees 6 inches DBH and greater.

Vegetation Zone	Total Acres	Trees/ Acre	Basal Area/Acre (sq. ft.)	QMD	Relative Density	Canopy Closure (%)	MBF/ Acre
Western Hemlock Zone	6,688	301	328	14.6"	87	89	68.2
Silver Fir Zone	503	385	360	13.1"	99	88	69.3

Table 2. Current average number of snags per acre by vegetation zone.

Vegetation Zone	Hard Snags per Acre	
	10-20" DBH	> 20" DBH
Western Hemlock Zone	13.7	0
Silver Fir Zone	0.2	0

The snags created in this stage of development are limited to lower diameter classes, relatively short-lived, and not large enough to accommodate larger cavity-nesting species. Table 2 above summarizes the current average number of snags per acre by diameter class. As opportunities for natural disturbances that create canopy openings are limited, it may be several decades before existing seedlings in the stand have enough light to grow and contribute to a more complex canopy structure.

3. Proposed Treatments

The Mt. Baker-Snoqualmie National Forest (MBS) proposes to thin young timber stands within the South Fork of the Stillaguamish River watershed, to enhance forest stand structure that will serve as habitat for old-growth associated species, enhance vegetation diversity in the Riparian Reserves, and promote stand resiliency to disturbance and climate change on a landscape scale. Younger stands (primarily 20 to 44 years of age) would be non-commercially thinned and older stands (typically 45 to 80) would be commercially thinned. Potential for thinning treatments was assessed on a landscape scale within both the Canyon Creek and main South Fork Stillaguamish River drainages. Thinning treatments would be applied on approximately 30 to 50 percent of the second-growth stands identified as a high priority for treatment to enhance development of late successional forest habitat.

Desired Conditions: Late Successional Reserves (LSRs) were designed to provide habitat for species associated with old growth forests. Providing desired levels of northern spotted owl and marbled murrelet habitat are specific management objectives for the Independence LSR. Historic owl and murrelet locations in the South Fork Stillaguamish watershed provided insights on forest plant association and stand structure associated with occupied sites. Connectivity or lack of connectivity between suitable nesting habitats was also considered when identifying stands for treatment. For marbled murrelet habitat, stands were reviewed for proximity to saltwater (20 to 45 miles) with stands closer to saltwater considered a potential benefit for breeding marbled murrelets. Shorter distances between foraging areas on salt water and forest nest sites would provide shorter feeding trips, less exposure time of adults to predators in flights and a shorter flight for a fledging murrelet from nest to saltwater. Shorter distance to saltwater could result in greater probability of successful addition of young to the population. Stands were also reviewed for the presence of mistletoe, an important structural component which could be encouraged with additional light from thinning for future murrelet nest branches. Habitat conditions for other species of concern were also assessed in describing a desired condition within the South Fork Stillaguamish watershed. Riparian Reserves were reviewed for desired habitat conditions as described in the Aquatic Conservation Strategy Objectives (Record of Decision (ROD) for

Amendments to Forest Service and Bureau of Land Management Planning Documents Within the Range of the Northern Spotted Owl, 1994). Riparian Reserve include those portions of the watershed required for maintaining hydrologic, geomorphic and ecologic processes that affect waterbodies and fish habitat. Riparian Reserves not only provide for the maintenance and enhancement of fish habitat but also a variety of other aquatic organisms and flora and fauna utilizing the more mesic conditions found in the Riparian Reserves (ROD B-12 to B-13). The Lake 22 Research Natural Area was one of the areas that provided reference conditions for the interdisciplinary team to review structurally diverse Riparian Reserve habitat.

Enhancement Opportunities: The current conditions of second growth stands in the project area were assessed for the opportunity to better meet desired late-successional structure and Riparian Reserve condition for a variety of species. Past timber harvesting crossed both upland slopes, riparian areas and streams, and while there was some pre-commercial thinning, much of the current stands have high tree densities, little diversity of understory, and limited stand structure in canopy height. The high stocking levels and homogenous stand conditions limit the development of stand structure for old forest associated species.

There is strong scientific support for active management of dense plantations to meet desired conditions. For example, in notes to the Regional Ecosystem Office from a meeting on January 18, 2001, the Science Findings Evaluation Group indicated “very strong support for active management (thinning, selective thinning, and possible under-planting) in young, dense forest stands” (Franklin 2001). Jerry Franklin, professor at the University of Washington, who specializes in old-growth forest ecology, supports thinning at different densities so that variable pathways can be established and biodiversity supported (Krohm and Franklin (1997), Lindermayer and Franklin (2002), Franklin et al. (2002), Franklin and Johnson (2010) and Churchill, et al.(2013).

Forest management can promote biocomplexity (Carey et al. 1999a, b). Thinning influences all forest structuring processes, including decadence and development of spatial heterogeneity. To restore degraded ecosystems, including establishment of biologically diverse and complex forests, active management, thinning, is needed (Carey and Curtis 1996; Lindenmayer and Franklin 2002, Carey 2003).

Studies by Harrington (2001), Reutebush et al. (2004), Harrington et al. (2004) Roberts et al. (2007) and Roberts and Harrington (2008) reported tree growth in thinned stands responded in a fairly short time with different growth response increasing structural diversity. Understory plant response to thinning was rapid. Harrington et al. (2004) described results from the Habitat Development Study in Washington, which treated stands 35-62 years old. The authors found that understory vegetation increased in coverage in almost all treatments and sub treatments.

Ares et al. (2009) described results from the Density Management Study in Oregon. This study found that understory vegetation richness increased 6 years after imposing 3 different thinning treatments in 40-60 year old stands, with increasing stand complexity from the recruitment of early seral and forest herbs, and both low and tall shrubs. This study also reported even greater species richness when prescriptions included gaps and leave islands as part of a variable thinning

treatment. Increased overstory variability encouraged development of multiple layers of understory vegetation. Trees retained per acre ranged from 121 in the light thin to 40 in the heaviest thin.

Neil and Puttermann (2013) assessed management practices on understory vegetation related to wildlife habitat with adjustments in overstory density and forest stand thinning. Thinning contributed to increased understory cover and diversity of wildlife forage and insect-pollinated species. Aries et al. (2013) concluded that thinning contributed to the development of a diverse plant understory, with plant groups having differing successional status, growth form and structure. Thinning may also influence ecosystem resilience by enhancing forest stand functional effects and response diversity.

Chan et al. (2006) concluded that in areas such as west slope forests, light availability is a principal driver in many of the processes that lead to increasing stand diversity and complexity. Bailey and Tappeiner (1998) concluded that thinning young Douglas-fir stands can set young stands on a trajectory towards achieving overstory and understory attributes similar to those in old-growth stands by promoting the development of understory tree species and tall- and low-shrub species.

Anderson et al. (2005) also confirmed that without silvicultural intervention or natural disturbances, young dense stands (170–247 trees/ac) would be unlikely to develop habitat features supporting spotted owl nesting within 160-year total stand age. Anderson et al. (2005) suggested that heavy thinning at ages 50 and 80 years, followed by tree-planting and additional thinning, would aid in development of forest patches structurally similar to habitat utilized by spotted owl for nest sites.

Cahall, R. E., J. P. Hayes, et al. (2013) found long-term response by forest birds to experimental thinning supports the “Field of Dreams” hypothesis. Implementing thinning at intervals across the landscape provides development of different seral stages and stand-structures. Thinning done while also maintaining unthinned areas for species negatively impacted by thinning, will likely have the greatest positive impact on beta diversity of birds in managed plantation landscapes.

Olson D.H. et al (2014) reported on findings from studies over a 10 year post-treatment period monitoring amphibian counts in old clear-cuts after subsequent thinning with various riparian buffer widths. The studies documented the headwater persistence of amphibians in managed headwater areas and resiliency of water fauna to habitat management. The study acknowledged potential risks from the riparian management with buffers of > 6-15 meters on streams, but found some positive response of species with these buffer widths. These studies suggest a mixed-buffer width approach, especially in drainages with other stream reaches not managed, provides long-term ecological restoration and addresses biodiversity.

The preponderance of the best available scientific evidence demonstrates thinning in dense managed stands can enhance conditions favorable for developing old growth upland and riparian forest characteristics and increasing habitat diversity.

The proposed action consists of forest stand management and connected ground-disturbing actions, road management actions, aquatic restoration actions and recreation management activities that implement the purpose and need of the South Fork Stillaguamish Project. Thinning treatments would be applied to a portion of the stands within a 65,000 acre project area. Road management maintenance levels would be changed to better align the road system maintenance with projected uses, and remove existing fish migration barriers to improve aquatic organism passage. Recreation sites in proximity to stand treatment areas would be upgraded to better meet needs identified at existing trailheads and travel routes.

The proposed action includes the following components:

Forest Vegetation Management

- Non-commercial thinning of densely stocked stands (walk-in, cut and leave downed trees)
- Commercial thinning of stands by removal of timber with the connected actions necessary for stand treatments

Other Actions within the Project Area

- Access management with road treatments (upgrades, storage, and decommissioning).
- Trail and trailhead upgrades and visual quality management.
- Aquatic organism passage improvements

Figure 2 is a map showing the proposed stands for treatments, the proposed road maintenance levels, proposed fish passage improvements, and recreation site changes.

Forest Stand Treatment - Non-commercial Thinning

Non-commercial thinning is the cutting of trees that are limiting growth and development of the forest stand, but are not large enough to produce harvested materials with commercial value. There are approximately 4,800 to 5,700 acres that would benefit from spacing of residual trees in non-commercial thinning where trees would be cut and left on-site. The total amount of acres treated would be determined by the funds generated by the commercial thinning in the project as well as other funding sources in future years.

Noncommercial stands are displayed in Figure 2 (proposed action)

Forest Stand Treatment - Commercial Thinning

While there are up to 7,200 acres of second-growth stands within 0.5 mile of an open road that have potential for commercial thinning, not all of those acres would have thinning treatments. The total acres treated would be determined during layout of the thinning units with the following areas excluded from commercial thinning activities:

- no-cut buffers on fish-bearing, perennial and intermittent streams, wetland and unstable soil areas
- areas of potential marbled murrelet nest trees,
- areas already exhibiting diversification of stand structure,
- areas dropped due to logging feasibility constraints and
- areas dropped due to uneconomical road reconstruction costs.

A range of approximately 30 to 50 percent (2,160 to 3,600 acres) of the potentially commercial stands would have ground-disturbance activities from proposed thinning. The range of acres that would be treated is based on the resource exclusions as well as mitigations and best management practices, with the resources considerations highlighted below.

Commercial Thinning - Hydrological Considerations

All perennial non-fish bearing streams would have a minimum of 30 feet of protection from harvest equipment and tree cutting. Ponds, wetlands, seeps and springs would also have at least 30 feet of protection, as well as unstable soil areas. Fish-bearing streams would be protected for at least 100 feet, including those streams designated as critical habitat for Puget Sound Bull Trout, steelhead, and Chinook salmon. Fish barriers to aquatic organism passage would be removed or replaced to promote aquatic habitat connectivity throughout the project area.

Commercial Thinning – Wildlife Considerations

The project would design the thinning to promote murrelet and owl nest structure, provide habitat connectivity and improve diversity of songbird habitat in riparian areas. In meeting the purpose and need for the project, the project would:

- No cut trees greater than 20 inches DBH (LSR guideline)
- Retain second growth suitable nesting structure within treated stands
- Protect raptor nests with no action buffers

Commercial Thinning – Recreation Considerations

The project area overlaps with a high-use recreation area and a scenic by-way route with Forest visual quality objectives. The project design and mitigation measures would minimize impacts of project implementation on recreation and visual quality where and when feasible. The project would:

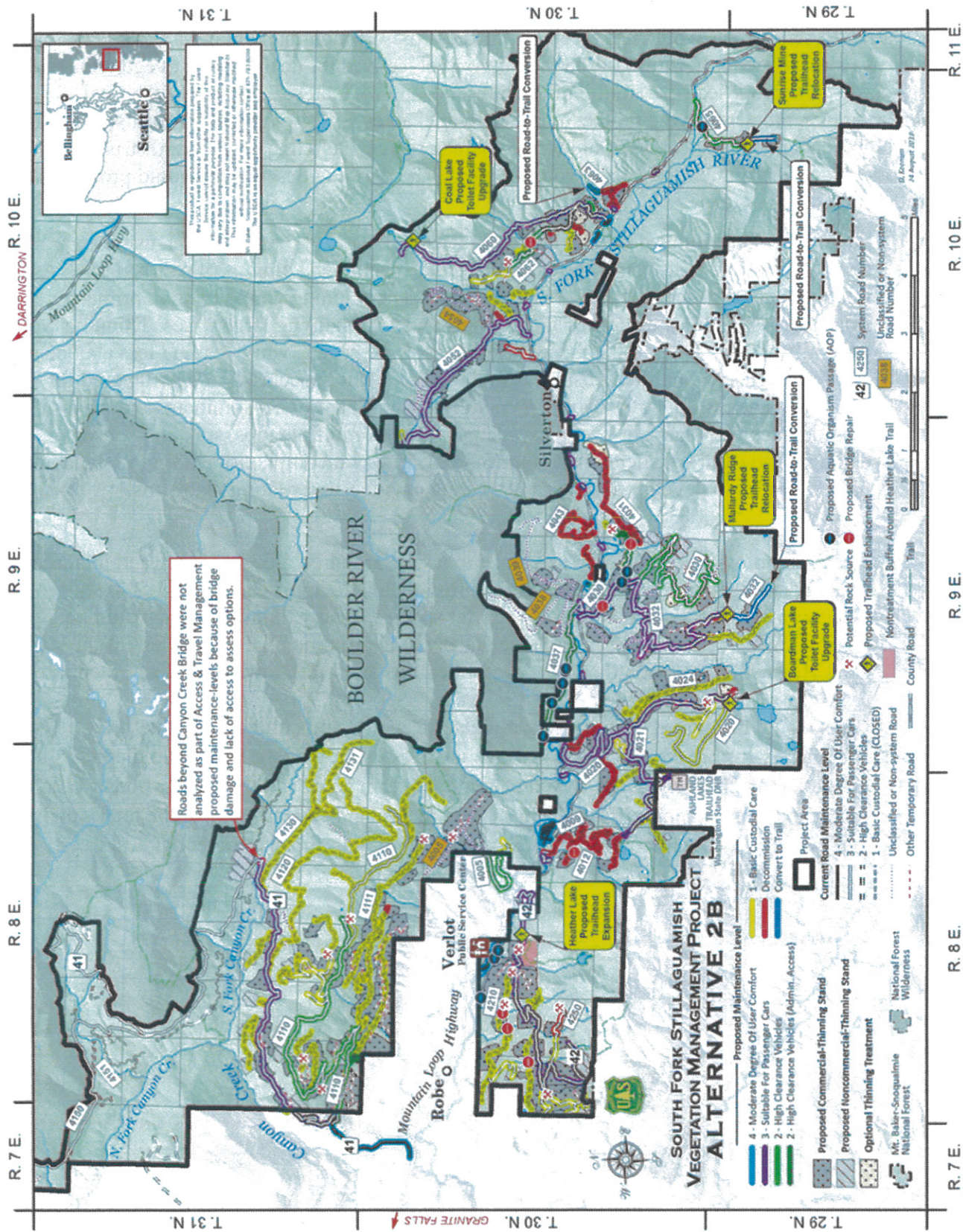
- Meet visual management objectives along the Mt. Loop Scenic By-way and routes to major trailheads with variable density thinning and buffers on trails.
- Provide 100 foot no-cut buffers on Heather Lake
- Minimize the duration of impacts to recreational access by limiting the number of trails closed at a given time, implementing complete road closures to shorten project duration or time needed to complete thinning activities, and minimize road and trail closures on weekends and holidays.
- Target road closure (Road 42) to Heather Lake trailhead for late season from after Labor Day in September to October 15th, but road closures of Road 42 may be implemented for public safety during the summer season for short durations.
- Retain roads open to trailheads on weekends and holidays (unless unforeseen safety situations arise).
- Maintain roads on haul routes to trailheads to reduce sediment contributions to the watershed, and provide safe recreation opportunities.

Commercial Thinning – Treatment Description

Commercial thinning would be applied on 2,160 to 3,600 acres. In this project the treated Riparian Reserve areas would not receive a different prescription than upland Late Successional Reserve slopes due to the similarity in the thinning objectives for desired forest vegetation and structure. The proposed riparian thinning represents approximately 7 percent of the total Riparian Reserve acres in the project area. All treated acres would emphasize forest stand development and enhancement of old forest characteristics, including species and structural diversity, and recruitment of coarse woody debris. The thinning description would provide the following:

1. Stands would be thinned to target relative density 35 ($RD = BA/(QMD^{1/2})$) using a variable density thin from below, incorporating irregular spacing and clumps of residual trees, as an intermediate treatment (not stand regeneration). The thinning would remove primarily smaller trees to allocate additional growing space to remaining larger trees. Thinning would generally remove trees of the most abundant conifer species, while leaving less abundant conifer species and hardwood species in the stand. Minor species would be favored for retention. The residual trees would generally be dominant or co-dominant, and may include trees with damage or defects such as root rot, multiple tops, spike tops, bear damage, and dwarf mistletoe that contribute to structural complexity within the stand and have potential to develop future snags, nesting cavities, and nesting platforms.
2. Heavy thinning areas would be used to emphasize large tree growing space and increase understory vegetation. Thinning would be from below to approximately 20-50 trees per acre, retaining hardwoods and minor conifer species. Heavy thinning areas would be approximately ½ acre to 3 acres in size and cover approximately 3-10 percent of the stand area. Heavy thinning would only be prescribed in stands with low windthrow potential.
3. Gaps would be created to increase stand heterogeneity, and culture individual trees specifically for big crowns and limbs. All conifers larger than the minimum diameter limit and less than 20 inches DBH would be removed from gaps, while all hardwoods would be retained. Gaps be approximately ¼ to ½ acre in size and cover 3-10% of the total stand area and avoid be located immediately adjacent to old growth forest or potential nest trees.

Biological Assessment - South Fork Stillaguamish Project
 Figure 2. Proposed Actions for the South Fork Stillaguamish Project.



4. Skipped areas would retain uncut, densely stocked areas in at least 10 percent of the stand area. Areas within stands proposed for treatment that would be left un-thinned include riparian no-cut buffers, hardwood and minor species areas, plant protection buffers, and areas otherwise unsuitable for commercial thinning. Additional skips may be designed as needed in stands that lack these features.
5. Stands greater than 80 years of age would not be treated. Any forested stands which are found to be 80 years of age or greater would be dropped from proposed treatment.
6. Trees greater than 20 inches DBH would not be cut. Any trees greater than 20 inches DBH that are required to be cut for safety or operational reasons, such as temporary road building, landing clearing, or log yarding, would remain on site as coarse woody debris.
7. Retain all snags and large downed wood. Snags and downed wood contribute to structural complexity and would be retained on site, undisturbed if possible with consideration for safe operational requirements. Any snags felled for safety reasons would be left on site.
8. Leave trees would be selected irrespective of whether the tree has any damage, so that trees with defects, potential cavity or nesting trees and other similar features of structural diversity may be retained in the units. In this case, the term "damage" refers to breakage, double tops, crooks, heart rots, ants, etc., that cause loss of wood volume, but usually won't kill the tree. Trees with fading crowns or bleeding boles indicative of root disease that may infect neighboring trees and create snags and coarse woody debris over time would be favored for retention.
9. Cedar and hardwoods: Western redcedar would be retained in stands where it is not currently well represented in species composition. Thinning in dense stocked cedar areas would occur in order to release cedar from competition. All Pacific yew within the stands would be retained. Alders and other hardwoods representation within the stands would be retained for mollusk and neo-tropical migrant bird habitat.
10. Leave Tree Protection: Limit skyline corridors to 15 feet in width where possible and include guy trees as part of the thinning prescription to reduce impact to residual stand (that is, if a guy tree is the largest tree in its vicinity and would otherwise be the "leave-tree", substitute the next largest tree as the "leave tree"). Tailhold trees that are damaged during operations would be retained and contribute to snags or coarse woody debris on site.
11. Potential Nest Tree protection: Marbled murrelet potential nest trees and old-growth legacy trees would be protected with retention of the adjacent tree(s) with interlaced or interlocked branches (typically 20 ft. radius). Potential nest trees are defined as having the features listed below:
 - Branch structure (or mistletoe broom) providing horizontal platform(s) ≥ 4 inches wide, 33 feet above ground or higher.
12. Coarse woody debris: Coarse woody debris (CWD), dead and down wood on the forest floor, existing on the site prior to thinning and exceeding 21 inches in diameter may be moved for access, but would not be removed from the site. Disturbance of existing CWD

exceeding 21 inches in diameter would be minimized to conserve CWD in the stands proposed for treatment. Temporary roads and skid trails would be closed after logging. Big, old stumps would be kept intact and not uprooted wherever possible.

13. Snag protection: Any legacy snags found in the stands would be buffered with a no-cut buffer radius equal to or greater than the height of the snag to protect forest workers and keep snags on site. In addition, all other snags would be retained unless they pose a hazard to human safety. Where possible, skips would be placed in locations that incorporate snags.
14. Soil Protection: Where cable harvesting systems are used logs will be yarded with either full or single-end suspension. Where cable corridors cross no-cut riparian buffers, full suspension will be maintained. Any trees felled for corridors within riparian no-cut buffers will be left on the ground. Cable corridors should be kept away from snags when possible. Where ground-based logging systems are used felling will be accomplished in a single pass of equipment. Skid roads will be approved by the sale administrator and equipment will travel on operationally generated slash as much as possible to minimize soil disturbance and compaction. Skid roads and trails will be spaced as widely as possible. Existing skid roads and trails should be used where possible.

Logging Systems: This project proposes to use both skyline and ground based logging systems (see Figure 6). Skyline logging systems use cables to transport logs to the landing. While transporting logs to the landing, logs are suspended on one end or are fully suspended, reducing soil disturbance. In skyline logging systems, trees are typically felled manually using chainsaws. In some cases, where soil protection goals can be met, mechanical felling equipment is used to pre-bunch the logs along skyline corridors.

Ground based logging systems can include numerous variations and combinations of equipment. Ground based systems typically used in this vicinity usually involve one of two primary methods of transporting the logs to the landing. Both systems use mechanical felling equipment in most cases. The most common method of transporting logs to the landing after felling uses a tractor or rubber-tired skidder to pull the logs along the ground behind the skidding equipment. Another commonly used piece of equipment for transporting logs to the landing is a forwarder. Forwarders transport logs off the ground in a bunk, generally causing less ground disturbance than a rubber-tired skidder or tractor. Traditional ground-based logging systems are used on slopes up to 35 percent.

Tethered assist ground-based systems may be used on steep slopes using a winch system to improve safety and efficiency of ground-based equipment while also reducing soil impacts from the felling and yarding operations. Tethered assist systems have been used on steep slopes (up to 80 percent) that have been logged in the past using skyline logging systems. The tethered systems use a cable anchored upslope of the felling and yarding equipment to assist with traction of the equipment (Sessions et al. 2016).

Approximately 2,160 acres to 3,600 acres of stands within the planning area would be commercially thinned, using both ground-based and skyline logging systems. Approximately 650 to 1,080 acres would be harvested with traditional ground based equipment operations on slopes of less than 35 percent. The rest of the 1,510 to 2,520 acres would either be skyline logged or potentially use self-leveling equipment on slopes up to 50 percent or more recently

developed tethered equipment on steeper slopes. Use of ground base equipment or tethered equipment decreases worker exposure to multiple hazards in the logging operations.

Forest Stand Treatment - Connected Actions

The proposed action would include the following connected actions associated with the timber harvest described above. These connected actions include best management practices and mitigations.

Roads. To facilitate the commercial thinning, the Proposed Action would require use of both open and closed Forest System roads.

- Use of 57 miles of open Forest System roads. Actions associated with use of these roads would be normal routine road maintenance on all the miles with spot reconstruction. Timber purchasers would be required to perform road repair and maintenance work as a condition of timber-sale contracts prior to using the roads. Road maintenance and repair would include rock resurfacing, blading and shaping road surfaces, roadside brushing and cleaning drainage structures.
- Reopening 29 miles of now-closed Forest System roads, and closing them after use. Reopening or reconstruction of roads may include fill repairs, culvert replacements, asphalt repair, road re-surfacing and bridge repairs with a variety of repairs from rock-surfacing, ditch clearing, should repairs to drainage improvements be anticipated. Temporarily opened stored roads would be hydrologically treated, waterbarred and closed through the timber sale contract after harvesting activities.
- Daylighting of the road prisms would be for safe passage of heavy equipment and reduction of tree debris fall that could plug or redirect drainage flows resulting in road erosion and impacts to streams. This would remove primarily the overhanging hardwoods within 30 ft. of the road edge and the removal of hazard trees (both conifer and hardwoods) up to 50 ft. from the road edge that are leaning into the road prism or otherwise posing a threat to safe use of the road prism.
- Fish barriers or barriers to other aquatic organism passage (e.g. failed or hanging culverts) on roads would be removed or replaced to promote aquatic habitat connectivity throughout the project area.

Temporary Roads. To facilitate harvesting of stands without open roads, the project would use on a temporary basis a number of unspecified or non-system road segments (12 miles) as well as use of road prisms from previously constructed temporary roads (16 miles) and 1.5 miles of new temporary road for a total of approximately 30 miles of temporary roads. The use of old system roads and temporary roads previously used in past timber harvest would limit the amount of new temporary road construction. Alternative 2 would allow for the removal of residual, nonfunctioning culverts in temporary roads and reconfiguring of drainage problems where old roads have intercepted or redirected flows.

- Reconstruction of 12 miles of unspecified Forest System roads and reconstruction of 16 miles of former temporary roads, with decommissioning of the roads after use. Work includes reestablishing a safe road prism, road re-surfacing with drainage improvements.

Biological Assessment - South Fork Stillaguamish Project

Temporarily opened roads would be hydrologically treated, and decommissioned after harvesting activities.¹

- Construction of 1.5 miles of new temporary roads with decommissioning of the roads following thinning activities.
- Open roads would be retained to administrative and recreational destinations. Closed roads and temporary roads would be reopened as summarized above and then closed to future use as described in the transportation section.

Rock Sources. To facilitate haul on system and temporary roads, some road surface rock would be required. Some of the surface rock for these roads may be supplied from commercial sources. However, rock also would be extracted and used from existing rock pits (Figure 2) and one new site, all located on National Forest System (NFS) lands:

- Blackjack (Rd 4031-015)- existing
- Boardman (Road 4020) - existing
- Pilchuck (Road 4240) - existing
- Green Mountain- five existing sites
- Road 4111,
- Road 4110
- Road 4110-024,
- Road 4113-012 and
- Road 4110 second switchback at junction with temporary road
- Beaver Creek (Rd 4062-030) - existing
- Lower Pilchuck (Road 42 at MP1.6) - existing
- Road 4210, at MP 0.08 - new rock site development
- Road 4210, existing site approximately 1.0 MP

Development of the rock source on Road 4210, at MP 0.08, would require removal of approximately 0.5 acres of second growth trees.

Water Sources. To facilitate road construction and maintenance as well as fire protection, water may be needed. Water drafting sites would be identified during project implementation. Water removal would be primarily along the main stem of the S.F. Stillaguamish and major tributaries at sites designated as per best management practices.

¹ As per standard timber sale contract clauses, temporary roads would be decommissioned following use. Decommissioning would include a variety of activities including the following: removal of culverts, reestablish natural drainage, removal of unstable side cast fills as necessary, ripping of road surface, blocking the road to motorized access, and potential revegetation.

Fuels Treatment

- Activity fuels within stands would not be treated due to the fuel loading at a project scale would not exceed Forest Plan objectives
- Slash on landings and the upslope side of roads would be disposed of when the following conditions are met: 1.) the road remains open to the public post treatment, 2) the slope is greater than 20 percent and 3) the slope is of a southern or non-northerly west aspect (azimuth from west at 270° counterclockwise to east-southeast at 112°).
 - Slash disposal at landings would remove fuels from within 150 feet uphill of these landings and from within 50 feet below or on flat ground adjacent to these landings.
 - Slash disposal on open roads would remove fuels from within 150 feet uphill of the open road.
- Slash disposal options may include a combination of the following: (1) redistribution of slash in the unit 2) piling and burning at the landing according to normal stipulations that protect air quality and standing live timber, (3) chipping and spreading to a depth of no more than 4 inches, and (4) fire wood permits.
- Whole-tree yarding would be permitted, but would have mitigations to prevent large accumulations of slash at log landings along roads that would remain open to the public.

Other Vegetation Management

- Treat invasive plants throughout the project area as per the direction in the ROD for the MBS Invasive Plant FEIS (2015).
- Revegetate areas of bare soil where designated (best management practices)

Other Proposed Actions within the Project Area

Recreation Site Improvements

The Proposed Action includes improving the condition of recreation sites and amenities in key recreation sites throughout the project area. Many recreation sites along the Mountain Loop Scenic Byway have outdated toilets, and do not have safe parking or sufficient parking capacity for the current level of use. The Proposed Action would upgrade toilet facilities at both Boardman Lake and Coal Lake trailheads. The Proposed Action would also remove culverts from the road section (National Forest System Road 4063) that is part of the Perry Creek Trail and reconfigure the culvert crossings for trail use. The Proposed Action includes the following trailhead actions:

Heather Lake Trailhead Expansion

The Heather Lake parking lot which currently has space for roughly 25 vehicles is filled to capacity on most weekends and holidays throughout the year causing visitors to park along both sides of the road which constricts traffic going to Mt. Pilchuck Trailhead and causes safety concerns for pedestrians walking along the roadside. The Proposed Action would expand the parking lot from approximately 25 parking slots to 75 by removing 1 acre of vegetation on the north side of the parking lot perimeter. Brush, rocks and most trees within the 1 acre footprint

would be removed. Wheel stops would be installed in the new parking slots. The total area of new disturbance would be approximately 1 acre.

Sunrise Mine Trailhead Relocation and Expansion

Similar to Heather Lake, this popular destination is often overcrowded causing visitors to park along both sides of an already narrow Forest road causing unsafe conditions for drivers driving on both sides of the road during the busy summer season. The Proposed Action would relocate the Sunrise Mine Trailhead back to a flat ridge approximately ½ mile north of the existing trailhead. The section of road between there and the current road end would be decommissioned and converted to trail following completion of stand treatments. Parking space for approximately 75 cars would be provided for the trailhead and picnic site combined by removing approximately 1-2 acres of vegetation along the east and west sides of the existing road.

Walt Bailey Trailhead Relocation and Expansion

Similar to Sunrise Mine, this trailhead would be relocated approximately 1 mile back along the road from its current location in a former log landing site. The section of road between there and the current road end would be decommissioned and converted to trail following completion of stand treatments. Parking slots for approximately 30 vehicles would be provided by removing less than ¼ acre of vegetation within a total area of disturbance of approximately 1 acre.

Aquatic Organism Passage Site Improvements

The Proposed Action includes improving the condition for aquatic organism passage in key sites throughout the project area. Culverts identified as barriers to fish migration within the project area would be replaced or removed as part of the Alternative 2 alternative or as resources become available. The barriers that exist on proposed haul routes would be upgraded (where needed for safe road use) while barriers that exist on closed roads would be removed as resources are available through the project actions or external funding. For barrier treatments, the objective would be to simulate physical conditions found in the natural stream environment. Channel crossing would be designed with information on channel dimensions, slope, and streambed structure so that water velocities and depths mimic natural hydrological conditions (USFS 2008). Thus, the simulated channel would present no more of an obstacle to aquatic animals than the natural channel.

Implementation of the above would require ground disturbance, largely within the road prism at the fish barrier location, but may include 25 to 50 feet in all directions to re-establish channel profile and/or floodplain habitat. The use of heavy equipment may require removal of ground cover, understory vegetation, and trees within this area for safe operation and full channel restoration. All areas of ground disturbance would be mulched or re-planted with native vegetation. Typical fish passage projects could close roads completely or to one lane for up to eight weeks depending on the size of the project.

Access and Travel Management

This project provided an opportunity to begin the needed assessment of recommendations in the Sustainable Road System Report (2015) for the road system within the project area of the SF of the Stillaguamish. The Proposed Action would:

- Decommission approximately 14 miles of National Forest System road no longer needed for forest management (currently non-drivable)

- Store approximately 15 miles of National Forest System roads and retain approximately 59 miles of National Forest System road in closed status Maintenance Level 1 (48 miles analyzed in Alternative 2), for a total of 74 miles in ML1 (63 miles analyzed in Alternative 2) for closed road status.
- Retain approximately 20 miles of National Forest System road in Maintenance Level 2 (16 miles analyzed in Alternative 2) for high clearance vehicles.
- Designate approximately 7 miles of National Forest System road as administrative closed Maintenance Level 2a (gated roads).
- Retain approximately 52 miles of National Forest System road in Maintenance Level 3, currently drivable passenger comfort ML (40 miles analyzed in Alternative 2)
- Retain approximately 5 miles of National Forest System road in Maintenance Level 4 (currently drivable – passenger comfort ML) (5 miles analyzed in Alternative 2).
- Convert approximately 1.8 mile of National Forest System road (3 road segments) into trail
- Use 22.6 miles of former National Forest System Road (dropped from current system list in the Forest database) as temporary roads and decommission.

Timing of Project Activities

Most activities would be completed within the next 10 to 15 years. Some actions related to timber sale preparation could begin at the earliest possible implementation date. Other actions, such as road to trail conversion or recreation site improvements would not begin until after thinning is completed and funding is secured from grants or other sources to complete construction. Connected actions may require sequencing over the 10 or more years with the commercial thinning activities which would occur over the course of several years. Road and trailhead construction activities, road decommissioning and aquatic organism passage activities, etc. would also occur intermittently, as funding becomes available through timber sales or other sources.

Management Requirements and Mitigation Measures are developed to avoid, reduce, eliminate, rectify, or compensate for undesirable effects from proposed activities. Unless noted otherwise in the decision document, the Management Requirements and Mitigation Measures are mandatory if the Responsible Official selects an action alternative for implementation.

The following management requirements and mitigation measures listed in Table 3 are specific to wildlife and were developed to address site-specific environmental concerns and to meet applicable Forest Plan standards and guidelines. There are numerous other management requirements and mitigation measures that address issues such as soil disturbance, erosion control, fisheries, botany, etc. that are not displayed below, but are displayed in the South Fork Stillaguamish Project environmental Assessment. Each measure or feature is stated, followed by its objective, a rating of its effectiveness and basis for that rating, a reference for the regulatory or scientific basis for the measure, and the person(s) responsible for enforcement.

Table 3. Wildlife Management Requirements and Mitigation Measures for Proposed Action

Wildlife Mitigation Measure or Project Design Feature	Objective	Effectiveness and Basis	Regulatory or Scientific Basis	Enforcement
W1 –Trees greater than 20 inches DBH will not be cut. Any trees greater than 20 inches DBH that are required to be cut for safety will remain on site as coarse woody debris. Safety or operational trees within 50 ft. of an open road would be considered for removal to reduce fuel loading and loss of wood to firewood cutters.	To maintain and retain late-successional conditions	HIGH Contract requirement	LSR plan implementation – exemption to REO letter	Timber sale contract and administrator, or their representative
W2 – Retain existing down woody debris and standing snags that are not deemed a hazard.	Maintain and enhance habitat diversity	MODERATE - LOW Availability within project stands.	Wildlife Forest-wide S&G (p. 4-124)	Timber sale contract and administrator, or their representative
W3 -- If raptor nest sites are found within the Project area during sale layout or implementation, activities will stop and a Forest Service Wildlife Biologist will be consulted. At the Wildlife Biologist's discretion, protective buffers and/or seasonal operation restrictions may be assigned to the newly located nest sites.	Minimize changes to microhabitat features adjacent existing nest sites & the protection of active nest site	HIGH Forest Experience	Migratory Bird Act Wildlife Forest-wide S&G (4-125)	Wildlife Biologist, Timber sale administrator, or their representative
W4 –Trees with interlocking branches with trees with suitable nest structure for owl and murrelet nest would be retained (visible suitable cavities or nest structure (platforms 4" at 30 ft.).	Maintain microhabitat conditions around potential nest trees	HIGH Forest Experience	ESA Section 7 consultation	Sale Preparation, Timber sale contract, layout and Timber sale administrator, or their representative
W5- Any tree \geq 21 inch dbh located in adjacent old-growth habitat proposed as a tailtree or anchor will first be field reviewed by a Forest Wildlife Biologist or their representative to determine if the selected tree is a spotted owl or marbled murrelet potential nest tree (PNT). All tailtrees will be retained as future wildlife trees, unless a hazard tree.	Protect occupied nest trees of federally protected species (northern spotted owl and marbled murrelet)	HIGH Contract requirement	Wildlife Forest-wide S&G (4-124)	Sale Preparation, Timber sale contract and administrator, or their representative

Biological Assessment - South Fork Stillaguamish Project

W6-The thinning prescription would designate an average of 10 wildlife trees/ac be retained that include dominant trees for future large snags, and marking of deformed green trees to retain for future wildlife trees. Desired wildlife trees/ac can be counted from skips, Riparian Reserve marking, murrelet leave trees, and snags from high stumping of hazard trees (20 ft – reach of ground equipment or 4 ft. height for sawyer on ground) and by leaving green trees around snags of greater than 21 inches.	Snags and green trees would be designated for retention during sale layout to meet standards and guidelines for cavity nesters	HIGH Contract requirement	Wildlife Forest-wide S&G (4-124)	Timber sale contract and administrator, or their representative
W7- Dominant trees infested with dwarf mistletoe will be retained in the thinning marking with thinning to occur within mistletoe stands to enhance light for growth.	Maintain and enhance murrelet nest structure and Hairstreak butterfly habitat	HIGH Contract requirement	Wildlife Forest-wide S&G (4-124)	Timber sale layout crew, TSA or their representative
W8 - Non-commercial thinning would operate with a Limited Operating Period from March 1 – July 15 to reduce adverse effects from harassment to spotted owls.	Reduce the potential disruption of spotted owl nesting	HIGH Contract requirement	ESA Section 7 consultation	Timber sale contract and administrator, or their representative
W9 - Non-commercial thinning would operate with a Limited Operating Period of daily crepuscular hours for activities between April 1 and September 23. Heavy equipment and other activities generating noise above ambient levels in historic owl or murrelet use areas, and occurring between April 1 and September 23 would operate within terms and conditions of the biological opinion for this project.	Reduce the potential disruption of marbled murrelet feedings or nesting.	Moderate 90% impacts reduction post-incubation stage; pre-incubation, the, mitigation would be ineffective	ESA Section 7 consultation	Timber sale contract and administrator, or their representative
W10 – Slash pile burning would occur during the time period of August 31 to February 28, outside of the spotted owl nesting season. In the event that burning activities cannot be accomplished in this work window, the wildlife biologist will be advised and work with fire staff to meet approved conditions for fire control and smoke management.	Reduce the potential disruption of spotted owl nesting and marbled murrelet feedings or nesting	HIGH Contract requirement	ESA Section 7 consultation	Forest fire staff and wildlife biologist
W-11 Use of biodegradable materials in wattles and other erosion control materials, unless removed following utilization.	Reduce impacts to amphibians and other small wildlife species that would get caught in the netting.	HIGH Contract requirement	Forest Plan – Maintain viable species - Forest plan goal – 4-124	Contract and Timber Sale Administrator, Project Engineer

Biological Assessment - South Fork Stillaguamish Project

W-12 Seasonal operating (October 31 to June 15th) restrictions would be utilized for operations in the project area that are located adjacent and within designated mountain goat habitat (MA-15) and within historic goat use area.	Protect and manage habitat to maintain or increase mt. goat populations	High	Forest Plan – Maintain viable species - Forest plan goal – 4-124 Administrative Use – Forest plan 4-234	Contract and Timber Sale Administrator, Wildlife Biologist
W13 -- If grizzly bear or gray wolf sites are found within the Project area during sale layout or implementation, activities will stop and a Forest Service Wildlife Biologist will be consulted. At the Wildlife Biologist's discretion, protective buffers and/or seasonal operation restrictions may be assigned to the newly located den/rendezvous sites.	Minimize impacts to bear and wolf den sites/rendezvous sites.	HIGH Forest Experience	ESA Section 7 consultation	Contract and Timber Sale Administrator, Wildlife Biologist

4. Affected Environment

Pre-field review: An office review of available information was conducted to determine if federally-listed or proposed animals, or designated critical habitat, may occur in the project area. Sources included Darrington Ranger District historic sighting records, historic survey and habitat inventory records, watershed analyses, geographic information systems habitat layers, and personal knowledge of the project area.

Table 4. Federally-listed Species and Designated Critical Habitat Known or Suspected in the South Fork Stillaguamish Project Area.

Species/Habitat	Status	Occurrence
Northern spotted owl (<i>Strix occidentalis caurina</i>)	Threatened	Documented
Marbled Murrelet (<i>Brachyramphus marmoratus</i>)	Threatened	Documented
Grizzly Bear (<i>Ursus arctos horribilis</i>)	Threatened	Suspected
Gray Wolf (<i>Canis lupus</i>)	Endangered	Suspected
Northern spotted owl Critical Habitat	Designated	Yes
Marbled murrelet Critical Habitat	Designated	Yes

Northern Spotted Owl

Activity Centers

Within the project area there are eleven historic owl activity centers. The project area is also within the home range (1.8 mile radius) of six additional historic owl activity centers. All owl activity centers are based on historic surveys in the 1990s. Owl territories in or near the project area have not been recently surveyed to protocol.

Table 5. Owl Activity Centers In and Adjacent to South Fork Stillaguamish Vegetation Project Area

Territory Name	Last Known Status	Activity Center Location in Relation to Project Area	Historic site Placement	Proposed Veg Treatment within Home Range	Proposed Veg Treatment within Core
Canyon West	RS	In	1987, 88 and 91 survey. Multiyear compilation site	N	N
Tupso	PR-R	Out	1987, 89, 90 & 91 surveys. PR/R -2 sites in 92 with Site locate on first PR/R detection	N	N
Spoon	PR-R	In	1991 Multiple detections. Site is Aug - adult 2 young	Y	Y
Seven	S	In	1991:1 detection, 1 year survey.	Y	Y
Green	PR	In	1991 1 year of surveys – pair location from July detection	Y	Y
Turlo / (Hemple)	RS	In	1 detection in 1990 and another single in 1991	Y	Y
Wiley	S	Out	1990- single year survey and single detection	Y	Y
Pilchuck	S	In	1980 and 1985 single detection off trails	Y	Y
Gordon	PR-R	In	1988 -90 surveys. 1988 PR/young site south of combined site	Y	Y
Mallardy	RS	In	1990 to 92 surveys- compilation of detections	Y	Y
Boardman	RS	In	1990 to 192 –upper sites DNR compilation of detections	Y	Y
Upper Clear	PR	Out	Compilation –Sauk drainage	Y	N
Deer	PR-R	In	1991-92, Site on 92 nest site	Y	Y
Marble	PR	Out	Williamson Creek	N	N
Perry	PR	In	Site compilation of 1989-92 surveys. Site on 92 nest	Y	Y

Biological Assessment - South Fork Stillaguamish Project

Barlow	PR	Out	Multiple detections -1987, 1989, 1994 1995 -compilation	Y	N
Falls	PR	Out	Sauk River drainage	N	N
PR-R: Pair Reproduction; PR: Pair; RS: Reproduction Suspected; S: Single					

The South Fork Stillaguamish project area is within a large Late Successional Reserve (Independence LSR 116) which encompasses most of the South Fork Stillaguamish River drainage. This LSR, with 60-80% of functioning late successional old-growth forest (LOS), is considered Priority 2 for restoration in the forest-wide late successional reserve assessment (LSRA) (USDA 2001). Here, 'functioning' refers to the amount of LOS within the LSR. Under the LSRA, the objective is to restore LOS to 80% or more of the LSR area. This analysis looks at the need for restoring total area, along with the pattern and distribution of LOS both within the LSR and the South Fork Stillaguamish project area.

Spotted Owl Prey Base

Other factors contributing to owl declines may be a low prey base. The flying squirrel (*Glaucomys sabrina*) is a major prey item for spotted owls in the North Cascades, and is a species associated with old-growth forest features of snags, downed logs and multi-layer canopy structure (Wilson, 2010). Flying squirrels forage on fungal sporocarps and field studies have positively correlated higher densities of flying squirrels to biomass and frequency of food (Gomez and others (2005). The variable densities of flying squirrels on the landscape are attributed to both food resources and forest structure (Gomez and others 2005, and Holloway and others, 2012). Holloway and others (2012) argued that forestry practices negatively influence flying squirrel abundance with the decrease in snag density and suggested that cavities for denning are a limiting resource for flying squirrels. Studies by Manning (2012) found that heavily thinned second growth stands had lower densities of flying squirrels than control or old-forest stands. Wilson (2010) suggested that protective cover for flying squirrels from predators such as owls and weasels may also be a limiting factor. There are no long-term studies to describe flying squirrel respond to thinning beyond 10 to 12 years, but papers by Manning (2012), Holloway and others (2012), and Wilson (2010) report densities of flying squirrel are sensitive to thinning in young Douglas-fir stands for up to a decade following treatment. The management of the young forests provides trade-offs between providing short-term, ephemeral habitat in dense unthinned stands and thinning treatments to promote development of more complex habitat in the long-term (Manning, 2012). These papers suggest a conservative landscape management strategy of maintaining connected, dense, closed-canopy forests (unthinned stands) within managed or thinned forests. However, Sollmann et al. (2016) suggests that while thinning had negative effects on flying squirrels density on the scale of a thinning unit, their results indicate that those effects were largely absorbed by the heterogeneous landscape, as animals shifted their distribution into unthinned areas without a decline in overall density.

Barred Owl

Barred owls have been detected across the South Fork Stillaguamish drainage. Increased habitat competition with the barred owl is one of the factors attributed to spotted owl decline (USFWS 2011). The barred owl population was noted in the early 1980's on the Forest and has continued to increase in the Pacific Northwest (Hamer et al 2007, Hamer 1998). In comparison with the spotted owl, the barred owl is slightly larger, has a wider array of diet items (Hamer et al 2001), is more aggressive and has a higher reproductive rate. Barred owls select nesting habitat structure comparable to spotted owls, but are found widely in second growth (suspected foraging), in habitat that is not as fully utilized by spotted owls. There exists a range-wide trend that spotted owls will continue to be displaced by increasing barred owl numbers (USDI 2008, 2011 and USDI 2012).

Disturbance

The early nesting season for spotted owl occurs from March 1 – May 30. During this time, owls initiate nesting and incubate eggs. Adverse effects from noise disturbance during the early nesting season are of concern due to the potential to interrupt optimal nest selection, or incubation success. Since most owl activities are nocturnal, noise from daytime activities are less likely to disrupt owl feeding or nesting activities. Disturbance after July 15 is not expected to adversely affect spotted owl nesting because young birds will be capable of flight and can move out of an area where noise affects them.

The project area encompasses the western portion of the Independence LSR 116 and contains areas suitable for nesting by spotted owls. Because of its size and expected contribution to spotted owl production, this LSR is very important to the success of the LSR conservation strategy adopted by the Northwest Forest Plan (USDA Forest Service and USDI Bureau of Land Management 1994). The LSR is expected to be a source of owls dispersing to two neighboring LSRs.

The Final Revised Recovery Plan for the Northern Spotted Owl (USDI 2011) recommends retaining all occupied and unoccupied, high quality spotted owl habitat on all lands to the maximum extent possible. This plan does not include specific recommendations on a network of management areas for spotted owl habitat, since the USFWS is in the process of conducting a range-wide, multi-step modeling process to design, assess, and inform designation of a habitat conservation network that will help address the recovery of the spotted owl.

Northern Spotted Owl Critical Habitat

The project area is entirely located within part of the 438,255 acre, Critical Habitat Unit (CHU)#4, West Cascades North subunit 1 (WCN-1) for the northern spotted owl (USDI 2012).

This LSR is a large block of national forest lands that provides east-west and north-south distribution of spotted owl habitat in the Washington portion of the Western Washington Cascades Range Province. Unit CHU#4 was established to provide nesting, roosting, foraging and dispersal for the recovery of the owl, which follows the objectives set aside for the LSR and

the recovery plan for the spotted owl (USDI 2011). The final rule on critical habitat supports management of forest stands in CHUs to restore structure associated with spotted owl use.

“Some proposed Federal forest management activities may have short-term adverse effects and long-term beneficial effects on the physical or biological features of northern spotted owl critical habitat. The Revised Recovery Plan for the Northern Spotted Owl recommends that land managers actively manage portions of both moist and dry forests to improve stand conditions and forest resiliency, which should benefit the long-term recovery of the northern spotted owl (USDI 2011). For example, variable thinning in single-story, uniform forest stands to promote the development of multistory structure and nest trees may result in short-term adverse impacts to the habitat’s current capability to support owl dispersal and foraging, but have long-term benefits by creating higher quality habitat that will better support territorial pairs of northern spotted owls. Such activities would have less impact in areas where foraging and dispersal habitat is not limiting, and ideally can be conducted in a manner that minimizes short-term negative impacts” (USDI 2012).

Marbled Murrelet

The murrelet continues to display an apparent declining population trend across its range (as was predicted in the Northwest Forest Plan), particularly in Washington. In Zone 1, there has been a declining trend of 3.9% of population/yr., or about 33% decline in population since monitoring began in 2001 (Falxa and Raphael 2016).

Numerous stressors have been identified that may be contributing to decline in population. Main stressors identified by the Recovery Implementation Team (USDI Fish and Wildlife Service 2011) are:

- Ongoing and historic loss of terrestrial (forest) nesting habitat
- Predation on murrelet eggs and chicks in their nests
- Changes in marine forage conditions, affecting the abundance, distribution and quality of murrelet prey
- Post-fledging mortality
- Cumulative and interactive effects of factors on individuals, populations, and the species

Surveys for murrelets are limited, with historic detections primarily in the 1990’s. Marbled murrelet detections (fly-overs and vocalizations) have been made in the South Fork Stillaguamish drainage (Forest Service Files), as well as activity associated with murrelet occupancy of sites for nesting. The first nest site discovered in the state of Washington was in the Lake 22 drainage in 1991. There are approximately 70 murrelet detections within the project area and approximately 12 detections adjacent to the project area (within 0.5 miles). Many of these detections occurred at survey points positioned on roads and landings and not in suitable nesting habitat. The project area ranges from approximately 18 to 36 miles from the salt water of Puget Sound.

On the Mt. Baker-Snoqualmie National Forest, murrelet activity associated with occupied murrelet sites has been most frequently recorded for sites within 40 miles of salt water. This is consistent with information in the critical habitat designation (<http://www.gpo.gov/fdsys/pkg/FR-2011-10-05/pdf/2011-25583.pdf>).

The second growth forests within the project area do not meet definitions of suitable murrelet nesting habitat on the Forest. Occupied habitat on the forest has been associated with old-growth forests and “All records of nests, eggs, eggshell fragments and downy chicks in Washington have been associated with old-growth forests.” (p. 145 to 55, General Technical Report PSW-GTR-152, 1995). There are adjacent stands within 0.5 mile of proposed units that have forest structure that would provide suitable murrelet nesting habitat and have historic detections of murrelets. Similar to the spotted owl, suitable murrelet habitat includes the conifer-dominated stands that generally are described as old growth with branch structure adequately developed to support nesting platforms. Nesting platforms (branches with flat surfaces greater than 4 inches at 33 feet height into the canopy) are capable of supporting a nesting adult and chick (Nelson et al 2002). Suitable murrelet habitat is described by USFWS (USDI 2016) as having at least one potential nest tree must be present in a stand of trees at least one acre of size, and the stand trees must be at least ½ the height of the site potential tree. In Washington, the murrelet nesting season, when eggs are incubated, extends from April 1 – September 23 (USDI 2012).

Daily flights between foraging areas and nest sites primarily occur during dawn and dusk hours, but may occur at during any daylight hour. During this season, it is a potential concern that adult birds could be flushed from nests due to a disturbance. It is possible that eggs could cool to the point that the embryo dies during the period that the adult is absent, or that predators could more easily detect nests, or have easier access to eggs, resulting in nest failure. After the chick has hatched, adult movements to feed the young are primarily in the early morning and evening hours, while the chick remains on the nest in a downy coat of cryptic camouflage.

There is suitable marbled murrelet nesting habitat within the project area.

Marbled Murrelet Critical Habitat

The project area is located entirely within part of the 104,707 acre Designated Critical Habitat unit (WA-09-b) for marbled murrelet (USDI 2016). The primary constituent elements include: 1) individual trees with potential nesting platforms, and 2) forested areas within 0.8 kilometers (0.5 miles) of individual trees with potential nesting platforms, and with a canopy height of at least one-half the site-potential tree height. Designated Critical Habitat also includes habitat that is currently unsuitable, but has the capability of becoming suitable habitat within 25 years.

Grizzly Bear

The North Cascades area north of Interstate 90 is part of a recovery zone for grizzly bear as outlined in the Recovery Plan of 1993 and 1997 Supplement (USDI Fish and Wildlife 1993 and USDI Fish and Wildlife Service 1997b). In 1997 the North Cascades Grizzly Bear Management Committee, which consists of the Park Superintendent of the North Cascades National Park and

the Forest Supervisors of the Wenatchee, Okanogan, and Mt. Baker-Snoqualmie National Forests, agreed to an interim standard of "No Net Loss" of core habitat until superseded by a Forest/Park Plan amendment or revision (USDA Forest Service and USDI Fish and Wildlife Service 1997).

Based on grizzly bear habitat use studies in Montana and British Columbia, core habitats were defined as those areas > 1/3 mile (500 m) from open roads, motorized or high use non-motorized trails. High use non-motorized trails are defined as trails with > 20 parties per week during bear seasons. The early bear season is defined as den emergence through early summer (March 15 through July 15) and the late season is defined as late summer to denning (July 16 through October 31). The baseline for the no net loss policy was based on mapped status of road and trail systems occurring in Bear Management Units (BMUs) as of July 31, 1997. Validation of road/trail status and use continues to be refined and updated with site specific project review.

The proposed activities occur in two grizzly BMUs. A status of 70 percent core habitat for interior BMUs and a status of 55 percent core habitat for exterior BMUs are considered desirable by the Interagency Grizzly Bear Committee (IGBC 2001). Both BMUs are considered exterior (USDA 1998). Based on the 1997 baseline analysis the Boulder BMU provides moderate quality core habitat, while the Pilchuck BMU is currently below the desired amount of core habitat in the early and late season (Table 6).

Table 6. 1997 Baseline of Percent Grizzly Core Habitat Within the Boulder and Pilchuck Bear Management Units.

BMU	Acres	% Federal Land	% Core Early Season	% Core Late Season
Boulder	168,202	81.1	56.0	53.0
Pilchuck	114,215	32.7	50.0	48.0

There are no recent Class 1 sightings (confirmed sightings) of grizzly on the Darrington District. The most recent Class 1 sighting occurred in 1996 over 16 miles east of the project area. If a grizzly den is located in the project area, the MBS would employ temporary restrictions related to the project (thinning operations, road building, blasting etc.) near den sites. Although the likelihood of an active den site in the project area is low, the MBS would cease thinning operations and road building within ¼ mile of a known active den site between October 30 and April 30.

Gray Wolf

Wolves are not habitat specialists, but are dependent on a sizeable ungulate prey base. Several recent modeling approaches described in the Washington Department of Fish and Wildlife (WDFW) 2011 Wolf Management Plan cite a variety of characteristics related to suitable habitat for wolves in WA State. The WDFW map of suitable habitat overlaps portions of the project area and the Forest. While the primary prey species of wolves are large ungulates, wolves will prey on smaller supplementary prey (e.g. beavers, rodents, birds etc.) (Newsome et al. 2016). On the

MBS, wolves could use a variety of prey items, but are expected to still be largely dependent on deer as a food source. Elk and deer populations are currently low, compared to those that resulted from past large-scale timber harvest and the resulting early-seral habitat. The wolf prey population (deer and elk) is limited and may be a factor in the lack of resident reproductive wolf populations' establishment on the west side of the North Cascades.

There has been recent detections of wolf activity on the west side of the Cascades. In May 2017, WDFW captured a single adult male wolf in the vicinity of Marblemount, WA (Skagit River drainage). During the summer-fall period of 2017 the animal utilized the Mt. Baker-Snoqualmie National Forest (MBS) and the North Cascades National Park (NOCA NP) as well as state and private lands west of the Cascade crest. The use area is approximately 40-50 km (25 - 30 miles) north of the project area. Presently it remains unclear if this is a single individual or if there are other wolves traveling with this animal. Future coordination between MBS NF and WDFW in April/May 2018 regarding the locations of wolves fit with GPS collars may reveal potential denning behavior and if subsequent temporary restrictions are advisable to protect pups. Wolves typically breed in February, the breeding female enters a den in late March/early April, and pups are typically born around mid-April (mean partition for ID, MT and WY).

Given the entire 10-15 year estimated project timeline and the current trajectory of wolf recolonization, it remains possible that wolves could utilize the MBS as dispersal habitat, and potentially occupy portions of the MBS as resident packs with possible den sites in the project area. If in 10-15 years a wolf den and/or rendezvous site is located in the project area, the MBS would employ temporary restrictions related to the project (thinning operations, road building, blasting etc.) near den and rendezvous sites. Wolf pups are generally mature enough to move out of a disturbed area (den and rendezvous sites) when they are approximately 5 months old, after September 1st. Although the likelihood of an active den site in the project area is low, the MBS would cease thinning operations and road building within ¼ mile of a known active den site between March 15th and September 1st. New information gained from following collared wolves would also be considered in applying protective measures if and when wolf denning activity is found within the project area.

For this analysis wolf security habitat is considered the same as core habitat for the grizzly bear.

5. Environmental Consequences and Effects Determinations

Northern Spotted Owl

Habitat

No suitable spotted owl nesting, roosting, or foraging habitat would be degraded or removed. Therefore, suitable spotted owl habitat would remain at current levels for functional fitness thresholds for core area and home range habitat conditions. The thresholds are based on a concept that it is necessary for a core area to have > 50% (approximately 500 acres) suitable habitat, and a home range to have >40% (approximately 2,600 acres) suitable habitat to maintain spotted owl life history functions associated with any given site. The spotted owl home range

size for the west side of the North Cascades is taken from the 1992 Draft Recovery Plan using a 1.8 mile radius circle from the activity center or nest site.

Seven spotted owl territories in the project area have at least 50% of their core area as suitable habitat (Table 7). Six of the territories have less than 40% of their home range as suitable habitat. Territories not meeting the thresholds are less likely to maintain spotted owl life history functions.

Table 7. Acres of suitable habitat by spotted owl territory for core area and home range.

Cluster Name	Spotted Owl Site	Cluster Number	Owl Number	Status	Acres Core	Acres Ring	Acres Home Range
BARLOW	20708	7	8	PR	572	2,857	3,429
BOARDMAN	26809	68	9	RS	522	1,868	2,390
CANYON WEST	24511	45	11	RS	652	1,751	2,403
DEER	27704	77	4	PR-R	375	2,239	2,614
GORDON	20313	3	13	PR-R	559	2,822	3,382
GREEN	28103	81	3	PR	378	1,677	2,055
MALLARDY	26906	69	6	RS	331	2,721	3,052
PERRY	26710	67	10	PR-R	463	2,385	2,848
PILCHUCK	20103	1	3	S	685	2,672	3,357
SEVEN	28501	85	1	S	364	1,667	2,032
SPOON	28304	83	4	PR-R	565	2,856	3,422
TUPSO	21211	12	11	PR-R	467	2,999	3,466
TURLO	28202	82	2	RS	229	1,607	1,836
UPPER CLEAR	24202	42	2	PR	532	1,860	2,392
WILEY	27101	71	1	S	453	2,447	2,900

Thirteen spotted owl territories have commercial thinning units proposed, with 11 owl territories having commercial thinning proposed in the core (Table 8). Nine territories have commercial thinning units in the territory and core area. It is expected that 2,160 to 3,600 acres of spotted owl dispersal habitat would be commercially thinned (Figure 3). Habitat would retain the qualities and functions of dispersal habitat because post-thinning stands would have a mean dbh of 11 inches or greater and more than 40% canopy closure (Thomas et al. 1990).

Thinning within the owl site core area was reviewed for each of the sites with proposed thinning, and all sites are recommended for thinning operations to encourage old forest characteristics in the core area. The Green Mountain pair site survey information portrays a pair from one season with no detection of reproductive activity in that year or subsequent years. Additional leave areas designed in the layout of the units with stand 60 and 62 would buffer the area from potential thinning operations impacts to the adjacent old growth. The designation of the units in the vicinity of the Deer Creek and Perry Creek pairs would also include additional leave buffers for the riparian reserve and trail buffer for Perry Creek. The Perry Creek historic pair site is further to the east on the survey forms from the GIS site. The Mallardy/Boardman sites are fragmented old growth and would also have additional riparian buffers to minimize impacts to old forests.

The Mallardy/Boardman sites represent a compilation of the detections in the area and not necessarily a nest site.

The thinning prescription, especially using focal tree designation would provide the opportunity to locate the thinning away from the interface of the old forest and second growth.

Non-commercial thinning would not impact spotted owl dispersal, foraging, roosting, or nesting habitat.

Trailhead expansion, trailhead relocation, and rock source development would impact up to 4 acres of spotted owl dispersal habitat. However, removal of 4 acres of dispersal habitat at three sites is not expected to impact to the function of dispersal habitat in the project area or critical habitat unit. Landscapes that contain at least 50 percent forest cover that is either suitable habitat or dispersal habitat are considered capable of supporting successful spotted owl dispersal (Thomas et al 1990). The removal of up to 4 acres of dispersal habitat is not likely to substantially affect spotted owls in the action area because spotted owls regularly disperse through highly fragmented landscapes that are typical in western Washington and western Oregon (Forsman et al. 2002).

Daylighting of all roads used for haul routes would provide safe passage of heavy equipment and reduction of tree debris fall that could plug or redirect drainage flows. This would remove primarily the overhanging hardwoods within 30 ft. of the road edge and the removal of hazard trees (both conifer and hardwoods) up to 50 ft. from the road edge that are leaning into the road prism or otherwise posing a threat to safe use of the road prism. No suitable nest trees are likely to be felled as a result of daylighting. Habitat along the roads is generally considered lower quality spotted owl habitat and with the low volume of trees planned for removal and minimal length of road, daylighting is likely to have no adverse effects to spotted owl habitat.

Prey Base

Papers by Manning (2012), Holloway and others (2012), and Wilson (2010) report densities of flying squirrel are sensitive to thinning in young Douglas-fir stands for up to a decade following treatment. The management of the young forests provides trade-offs between providing short-term, ephemeral habitat in dense unthinned stands and thinning treatments to promote development of more complex habitat in the long-term (Manning, 2012).

However, Sollmann et al. (2016) suggests that while thinning had negative effects on flying squirrels density on the scale of a thinning unit, their results indicate that those effects were largely absorbed by the heterogeneous landscape, as animals shifted their distribution into unthinned areas without a decline in overall density. Therefore, commercial thinning is not expected to have a large impact on flying squirrel densities in the project area.

Disturbance

Approximately 1,685 acres of suitable nesting, roosting, and foraging habitat occurs within 65 yards of areas with expected noise generating activities. This represents approximately 6 percent of the habitat in the project area. Any owls nesting in those areas would be subject to adverse

effects from March 1 through July 15. Although up to 1,685 acres could be subject adverse effects from noise disturbance, some noise generating activity is likely to occur outside the early nesting season. Noise disturbance would be distributed across the landscape with noise disturbance expected on only a portion of suitable nesting, roosting, and foraging habitat at any one time. The project would be implemented in 4 to 5 sales over 2 – 3 years/sale so there would be approximately 25 to 50 percent of the owl habitat with noise disturbance in a given year. No adverse effects are expected to occur outside the early nesting season.

As a result the proposed action may affect, and is likely adversely affect the spotted owl due to noise disturbance during the nesting season.

Northern Spotted Owl Critical Habitat

There would be no effects to current primary constituent elements of nesting, roosting or foraging habitat. However, commercial thinning, trailhead expansion, trailhead relocation, road daylighting, and rock source development is expected to impact the primary constituent element of spotted owl dispersal habitat.

The thinning units (2,160 to 3,600 acres) would retain their ability to provide dispersal habitat and it is expected that these areas would develop into nesting, roosting, and forage habitat earlier than if left untreated.

Trailhead expansion, trailhead relocation, and rock source development would remove up to 4 acres of dispersal habitat in three areas. However, removal of 4 acres of dispersal habitat at three sites is not expected to impact to the function of dispersal habitat in the project area or critical habitat unit. Landscapes that contain at least 50 percent forest cover that is either suitable habitat or dispersal habitat are considered capable of supporting successful spotted owl dispersal (Thomas et al 1990). The removal of up to 4 acres of dispersal habitat is not likely to substantially affect spotted owls in the action area because spotted owls regularly disperse through highly fragmented landscapes that are typical in western Washington and western Oregon (Forsman et al 2002).

Daylighting of all roads used for haul routes would provide safe passage of heavy equipment and reduction of tree debris fall that could plug or redirect drainage flows. This would remove primarily the overhanging hardwoods within 30 ft. of the road edge and the removal of hazard trees (both conifer and hardwoods) up to 50 ft. from the road edge that are leaning into the road prism or otherwise posing a threat to safe use of the road prism. No suitable nest trees are likely to be felled as a result of daylighting. Nesting, roosting, foraging, and dispersal habitat along the roads is generally considered lower quality and with the low volume of trees planned for removal and minimal length of road, daylighting is likely to have no adverse effects to primary constituent elements of spotted owl critical habitat.

As a result, this alternative may affect, but is not likely to adversely affect spotted owl designated critical habitat.

Figure 3. Proposed Commercial and Non-commercial Thinning in Historic Spotted Owl Territories.

Alternative 2B

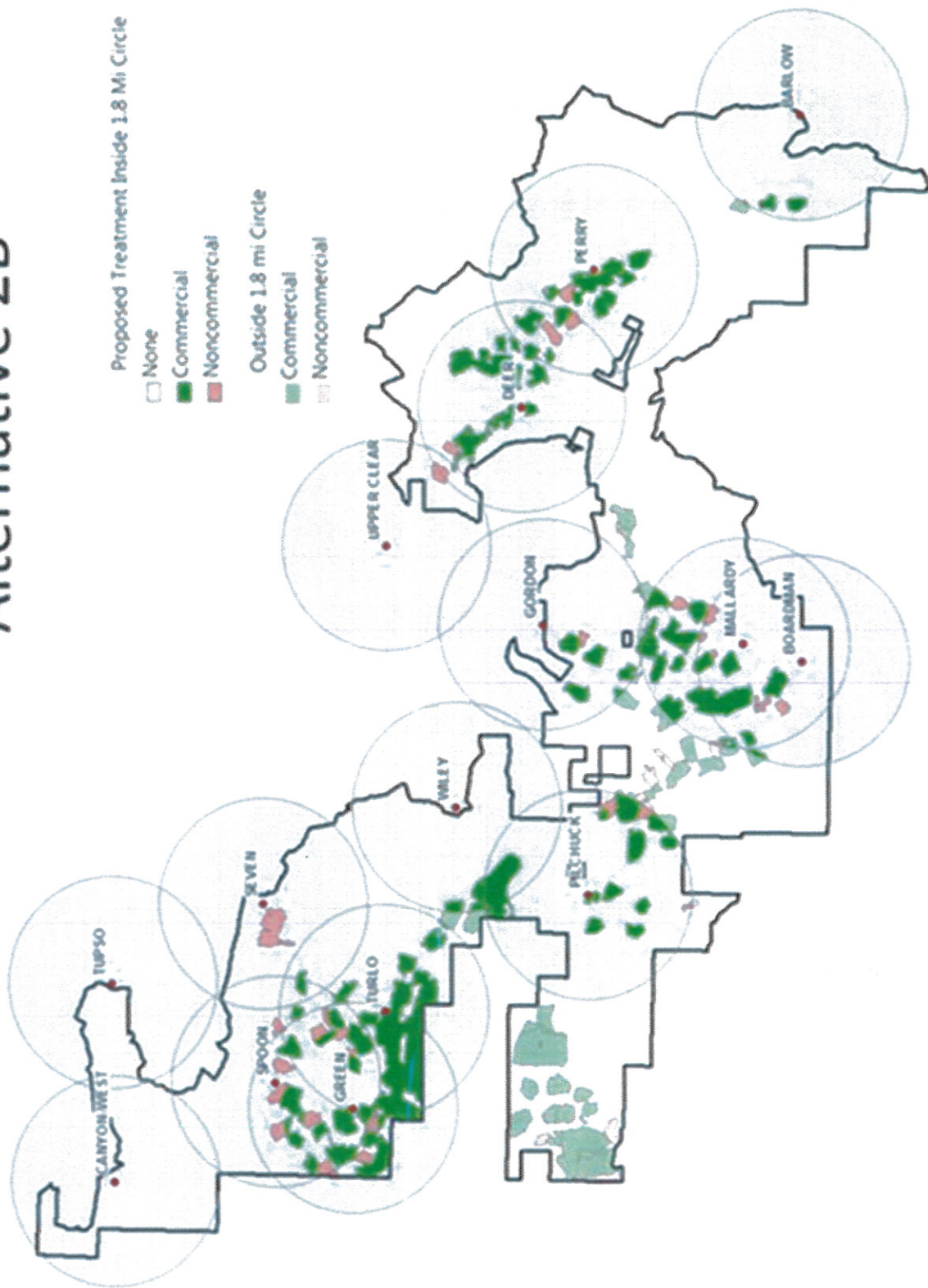


Table 8. Acres of Proposed Commercial and Non-commercial Thinning by Historic Spotted Owl Territory.

Cluster Name	Spotted Owl Site	Cluster Number	Owl Number	Status	Activity Center	Treatment Type	Alternative 2B			
							0.7 Mile Circle Acres	Percent	1.8 Mile Circle Acres	Percent
BARLOW	20708	7	8	PR	CUR	None	985	100%	6445	99%
BARLOW	20708	7	8	PR	CUR	Commercial	0	0%	69	1%
						Total	985	100%	6514	100%
BOARDMAN	26809	68	9	RS	CUR	None	925	94%	6020	92%
BOARDMAN	26809	68	9	RS	CUR	Commercial	60	6%	398	6%
BOARDMAN	26809	68	9	RS	CUR	Noncommercial	0	0%	96	2%
						Total	985	100%	6514	100%
CANYON WEST	24511	45	11	RS	CUR	None	985	100%	6514	100%
						Total	985	100%	6514	100%
DEER	27704	77	4	PR-R	CUR	None	807	82%	5698	87%
DEER	27704	77	4	PR-R	CUR	Commercial	178	18%	699	11%
DEER	27704	77	4	PR-R	CUR	Noncommercial	0	0%	117	2%
						Total	985	100%	6514	100%
GORDON	20313	3	13	PR-R	CUR	None	927	94%	6235	96%
GORDON	20313	3	13	PR-R	CUR	Commercial	53	5%	261	4%
GORDON	20313	3	13	PR-R	CUR	Noncommercial	5	1%	18	0%
						Total	985	100%	6514	100%
GREEN	28103	81	3	PR	CUR	None	652	66%	4520	70%
GREEN	28103	81	3	PR	CUR	Commercial	288	29%	1647	25%
GREEN	28103	81	3	PR	CUR	Noncommercial	45	5%	347	5%
						Total	985	100%	6514	100%
MALLARDY	26906	69	6	RS	CUR	None	898	91%	5425	83%
MALLARDY	26906	69	6	RS	CUR	Commercial	71	7%	944	15%
MALLARDY	26906	69	6	RS	CUR	Noncommercial	16	2%	145	2%
						Total	985	100%	6514	100%

Biological Assessment - South Fork Stillaguamish Project

Cluster Name	Spotted Owl Site	Cluster Number	Owl Number	Status	Activity Center	Treatment Type	Alternative 2B		
							0.7 Mile Circle Acres	Percent	1.8 Mile Circle Acres
PERRY	26710	67	10	PR-R	CUR	None	677	69%	5885
PERRY	26710	67	10	PR-R	CUR	Commercial	279	28%	516
PERRY	26710	67	10	PR-R	CUR	Noncommercial	29	3%	113
						Total	985	100%	6514
PILCHUCK	20103	1	3	S	HIST	None	887	90%	5734
PILCHUCK	20103	1	3	S	HIST	Commercial	98	10%	712
PILCHUCK	20103	1	3	S	HIST	Noncommercial	0	0%	68
						Total	985	100%	6514
SEVEN	28501	85	1	S	CUR	None	859	87%	6338
SEVEN	28501	85	1	S	CUR	Commercial	0	0%	33
SEVEN	28501	85	1	S	CUR	Noncommercial	126	13%	143
						Total	985	100%	6514
SPOON	28304	83	4	PR-R	CUR	None	770	78%	5426
SPOON	28304	83	4	PR-R	CUR	Commercial	133	14%	774
SPOON	28304	83	4	PR-R	CUR	Noncommercial	82	8%	314
						Total	985	100%	6514
TUPSO	21211	12	11	PR-R	CUR	None	985	100%	6514
						Total	985	100%	6514
TURLO	28202	82	2	RS	CUR	None	507	51%	4955
TURLO	28202	82	2	RS	CUR	Commercial	478	49%	1471
TURLO	28202	82	2	RS	CUR	Noncommercial	0	0%	88
						Total	985	100%	6514
UPPER CLEAR	24202	42	2	PR	CUR	None	985	100%	6466
UPPER CLEAR	24202	42	2	PR	CUR	Commercial	0	0%	3
UPPER CLEAR	24202	42	2	PR	CUR	Noncommercial	0	0%	45
						Total	985	100%	6514
WILEY	27101	71	1	S	CUR	None	985	100%	6210
WILEY	27101	71	1	S	CUR	Commercial	0	0%	304
						Total	985	100%	6514

Figure 4. Proposed Commercial Thinning Units and Suitable Spotted Owl Habitat.



This is a map product of the Northwest Forest Plan Interagency Regional Monitoring Program. It represents northern spotted owl habitat as of 2006 in Oregon and Washington, and 2007 in California, as described in chapter three of Davis et al. (2011)

NSO – Habitat (South Fork Stillaguamish River Watershed)

	Habitat Class	Acres	Percent of Area
Watershed	Nesting/Roosting Habitat	45,647	28%
	Dispersal Habitat	61,794	38%
	Forested, but Not Dispersal Habitat	42,696	26%
	Nonforested	12,207	8%
	Total	162,344	100%
Project Area	Nesting/Roosting Habitat	27,986	43%
	Dispersal Habitat	25,204	39%
	Forested, but not Dispersal Habitat	8,711	13%
	Nonforested	3,327	5%
	Total	65,228	100%

Marbled Murrelet

Habitat

There is proposed thinning within 0.5 mile of 41 murrelet detection sites (Figure 5). However, many of these detections occurred at survey points positioned on roads and landings and not in suitable nesting habitat. Commercial and non-commercial thinning would not occur in suitable murrelet nesting habitat. Trailhead expansion, trailhead relocation, and rock source development would not occur in suitable nesting habitat. Therefore there would be no effect to nesting habitat.

Daylighting of all roads used for haul routes would provide safe passage of heavy equipment and reduction of tree debris fall that could plug or redirect drainage flows. This would remove primarily the overhanging hardwoods within 30 ft. of the road edge and the removal of hazard trees (both conifer and hardwoods) up to 50 ft. from the road edge that are leaning into the road prism or otherwise posing a threat to safe use of the road prism. No suitable nest trees are likely to be felled as a result of daylighting. Nesting habitat along the roads is generally considered lower quality and with the low volume of trees planned for removal and minimal length of road, daylighting is likely to have no adverse effects to murrelet habitat.

Disturbance

Approximately 2,667 acres of suitable nesting habitat occurs within 110 yards of areas with expected noise generating activities (Figure 6). The 2,667 acres with potential noise impacts was generated by projecting out from the stand boundary 110 yards into adjacent old growth with suitable nesting habitat. This acreage from the boundary of the stand proposed for thinning treatment does not reflect the smaller final configuration of the thinning unit that results during the thinning sale layout. During sale unit layout, riparian no-cut buffers are designated as well as the prescribed buffers to unstable areas, wetlands, visual areas and trails. Areas with difficult logging logistics are also dropped. Therefore, this impacted acreage which represents approximately 9 percent of the nesting habitat in the project area is a high projection of the amount of old growth area that would have noise impacts, with the final area expected to be a smaller amount of acres once the unit boundaries and buffers are delineated. Any murrelets nesting in areas with noise intrusions would be subject to potential adverse effects from April 1 through September 23. Although up to 2,667 acres were calculated to be within a zone influenced from noise disturbance, some noise generating activity is likely to occur outside the nesting season. The disturbance would also be distributed across the landscape over time with noise disturbance expected on only a portion of suitable nesting habitat at any one time. The project would be implemented in 4 to 5 sales over 2 – 3 years/sale so there would approximately 25 to 50 percent of the murrelet nesting habitat with noise disturbance in a given year.

In order to evaluate noise impacts to suitable murrelet nesting habitat, the Forest reviewed the Forest location where previous occupied behavior was detected as well as murrelet presence or fly-over activity (See new figure 5). The habitat of the occupied sites was reviewed with the suitable habitat identified in the Northwest Forest Plan Interagency Regional Monitoring Program. Figure 6 represents marbled murrelet nesting habitat suitability as of 2006 in Washington, as described in Raphael et al. (2011). This review assisted in focusing on the habitat adjacent to the second growth forest that is not only old growth, but has historic occupied

detections or had stand characteristics of the occupied sites (tree height and density). The second growth stands in proximity to high quality or occupied habitat would have unit design and thinning prescriptions to minimize openings adjacent to the old growth.

The Forest is currently proposing to use unit design vs. seasonal restrictions and limited operating periods (LOPs) to address potential noise disturbance to old forest habitat. The concern with the LOPs include a number of considerations that include

- Logging logistics for partial unit operations is difficult to implement. In some locations, this could work where there are logical breaks in the operations (Stand u43 – above the road, there are slopes with a different operating equipment than below the road – ground based). In other locations, the logging system would not provide a logical break in the unit. The partial unit operations also are a concern for the mobilization costs and timing of operations so as to limit the time that roads are closed to the public and recreating visitors.
- Road work would be needed before thinning operations so any LOPs would need to include road work within the breeding season.
- LOPS would push work into less desirable work seasons. Operations in the wet or fall/winter season has more potential for sediment delivery to streams which is in conflict with fisheries and water quality concerns.
- LOPS can result in a longer time period for operations in any one location resulting in multiyear disturbances to birds vs. a shorter disturbance time in years,
- LOPs would likely result in multiyear temporary roads. Temporary roads on the landscape for more than one year are less desirable in resource impacts with additional impacts from putting roads to bed over winter which can be costly in both resource impacts and cost of operations.
- LOPS in conjunction with fire shutdown period in the summer create a very limited operating season, with equipment tied up on a site and yet unable to operate.
- Due to the above, LOPS are more costly for an operator to work with. The more costly the operations, the less chance there is of having operators willing to bid and implement the thinning treatments. The LOPs would result in less chance of accomplishing the purpose and need that the stand treatments are designed for.

As a result this alternative may affect, and is likely adversely affect the marbled murrelet due to noise disturbance during the nesting season.

Marbled Murrelet Critical Habitat

There would be no effects to current nesting habitat. However, commercial thinning, trailhead expansion, trailhead relocation, road daylighting, and rock source development is expected to remove primary constituent elements of (PCE) of murrelet critical habitat. PCEs of murrelet critical habitat include: 1) individual trees with potential nesting platforms, and 2) forested areas within 0.8 kilometers (0.5 miles) of individual trees with potential nesting platforms, and with a canopy height of at least one-half the site-potential tree height.

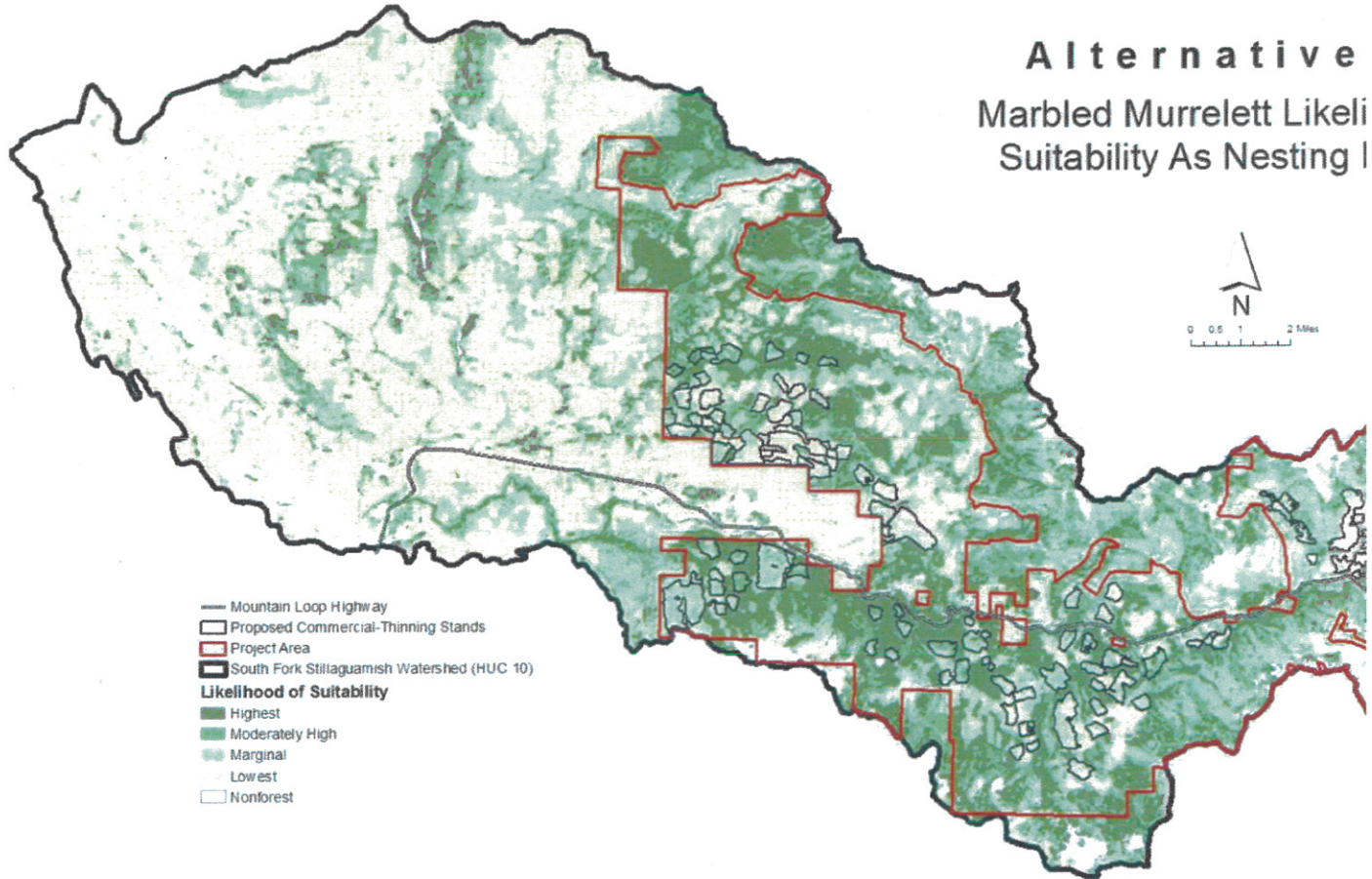
No PCE-1 trees would be impacted by commercial thinning, trailhead expansion, trailhead relocation, and rock source development as this would occur in second growth stands that, in this project area, would not likely to support platforms particularly in trees less than 26 inches dbh. While trees larger than 20 inch dbh would not be cut, trees that may occur within thinning units that are adjacent to possible nest trees (PCE-1) would be retained. PCE-1 trees would not be heavily affected by removal of hazard trees because hazard trees are unlikely to be potential murrelet nest trees.

PCE-2 trees would be impacted by commercial thinning, trailhead expansion, trailhead relocation, road daylighting, and rock source development. The thinning units and road side stands being daylighted would not impact the stands' ability to provide microclimate and windthrow protection, and provide cover to any nesting murrelets. Removal of 4 acres of PCE-2 trees at three sites is also not expected to impact to the function of providing microclimate and windthrow protection to PCE-1 trees. Therefore, the effect of the proposed action would not change the function of PCE-2 at the areas scale nor measurably affect suitable nest trees (PCE-1).

Thinning the second growth stands within critical habitat would promote development of future nesting habitat. Thinning would result in a more open canopy area within habitat not suitable for nesting murrelets. As the treated stands mature and develop branching structure for nesting murrelets, canopy closure and in-growth in the gaps would reduce the potential for corvid use of the thinned areas. Therefore, the thinning impacts would be short-term impacts in unsuitable habitat within the critical habitat designation, with potential long-term beneficial effects of reduced stocking levels in the second growth. Reduced stocking levels of trees per acre would reduce within-stand competition, allowing development of growth on fewer residual trees. This would promote large diameter trees with more pronounced crowns and development of large, lateral branches for future nesting habitat (USDA Forest Service, 2001).

As a result, this alternative may affect, but is not likely to adversely affect marbled murrelet designated critical habitat.

Figure 5. Proposed Commercial Thinning Units and Suitable Marbled Murrelet Habitat.



This is a map product of the Northwest Forest Plan Interagency Regional Monitoring Program. It represents marbled murrelet nesting habitat suitability as of 2006 in Washington, as described in Raphael et al. (2011).

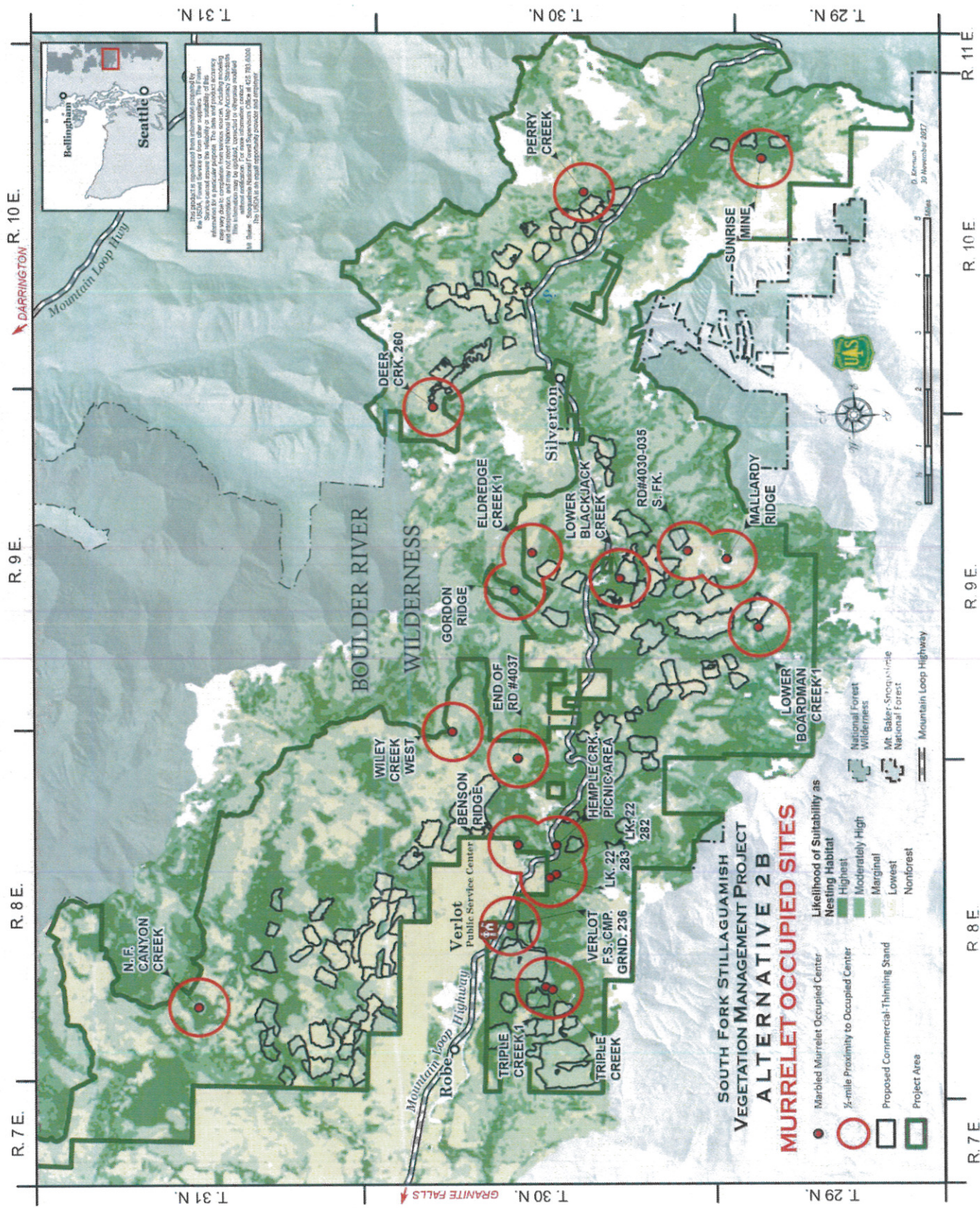
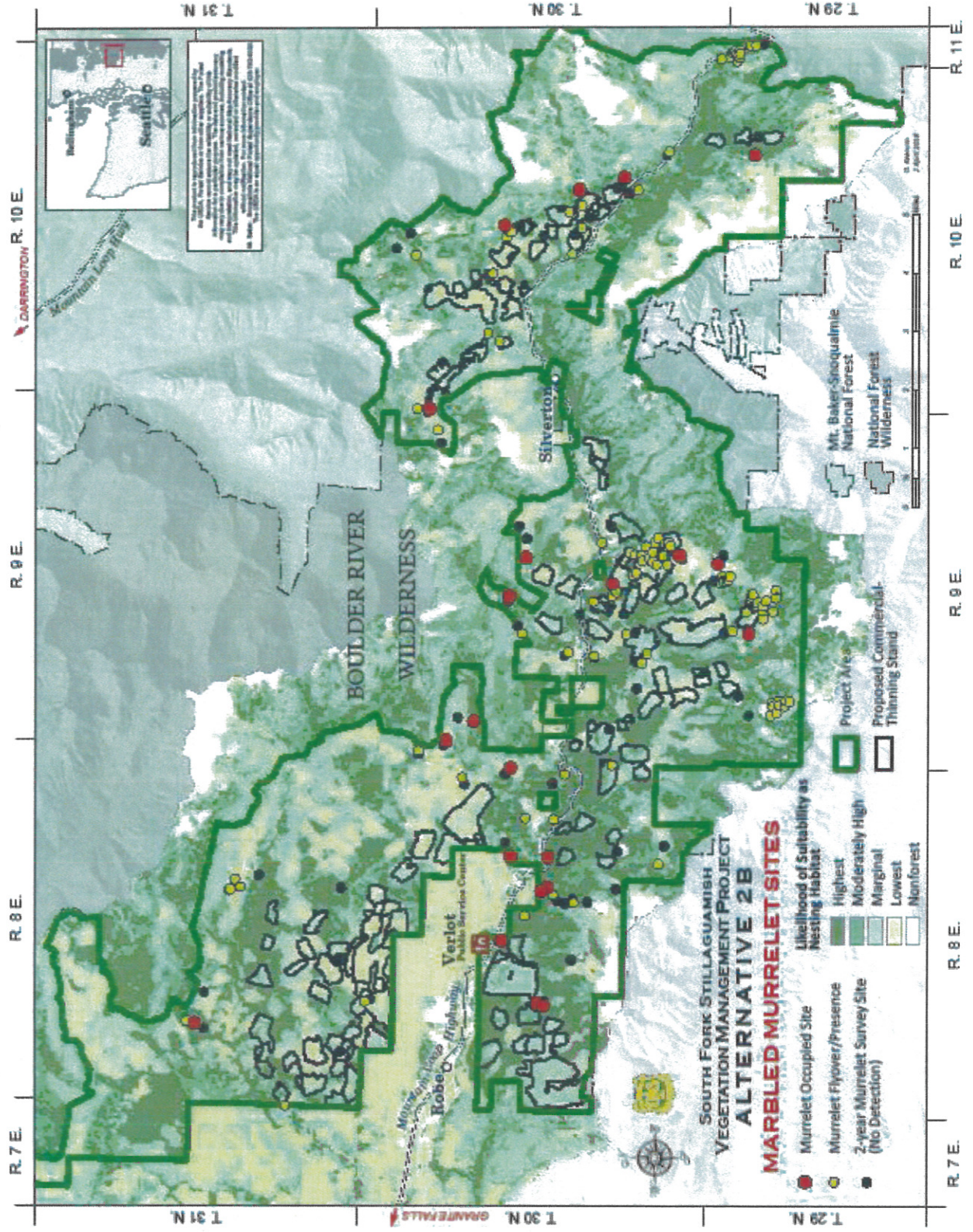


Figure 7. Proposed Commercial Thinning Units, Suitable Marbled Murrelet Habitat, and Historic Survey Detections.
This is a map product of the Northwest Forest Plan Interagency Regional Monitoring Program. It represents marbled murrelet nesting habitat suitability as of 2006 in Washington, as described in Raphael et al. (2011).



MAMU – Likelihood of Suitability As Nesting Habitat (South Fork Stillaguamish River Watershed)

	Likelihood of Suitability	Acres	Percent of Area
Watershed	Highest	24,732	15%
	Moderately High	22,794	14%
	Marginal	47,781	30%
	Lowest	55,171	34%
	Nonforest	11,866	7%
	Total	162,344	100%
Project Area	Highest	16,649	25%
	Moderately High	12,241	19%
	Marginal	22,634	35%
	Lowest	10,463	16%
	Nonforested	3,241	5%
	Total	65,228	100%

Grizzly Bear

There have not been any recent class 1 sightings of grizzly bears in the North Cascades Ecosystem (NCE) since 1996, and no current evidence to support the conclusion that a viable population (i.e. >1 female with cubs) exists in the NCE at present. However, the USFWS and the NPS are presently determining how to restore grizzly bears to the NCE and in 2017, prepared a draft EIS outlining objectives and alternatives. Among the alternatives are descriptions of potential release areas, and the southernmost of these potential areas includes portions of the Glacier Peak Wilderness. While the prospective release sites remain tentative, the SF Stillaguamish project area is located, conceivably, within approximately 80-120 km (50-75 miles) of a prospective wilderness area release site. Given that female grizzly bears in the south Selkirk range (the closest grizzly bear population that occupies portions of northern Idaho, NE Washington and SE British Columbia) have a mean home ranges size = 655 km² (Kasworm et al. 2016). Therefore, while it is a low probability, it is plausible that bears reintroduced east of the SF Stillaguamish project area, might disperse from the release area and utilize portions of the Boulder and Pilchuck Bear Management Units (BMUs) within the duration of the vegetation management project (10-15 years). If grizzly bears are introduced, it is expected that all adult bears would be fit with GPS collars and their locations closely monitored. The MBS would coordinate with the USFWS (the co-lead agency for grizzly bear reintroduction) regarding locations of bears on the MBS and whether a female grizzly bear localizes in the project area.

In the Forest Programmatic Biological Assessment, dens sites were identified for potential seasonal restrictions. Project activities with noise above ambient levels within 0.25 miles of known grizzly bear den sites would be restricted between October 30 and April 30. This would avoid the post den emergence and initial spring habitat green-up period. That limitation in operations would reduce the likelihood of disturbance and displacement of a female (and cub). The Forest assessment of the Boulder and Pilchuck BMUs are that these areas are both exterior BMUs and exhibit moderate habitat quality.

However, given the mean home range area of grizzly bears, the BMUs (which contain the project area) are within dispersal range of potential grizzly bear release sites and may be utilized. Information gained from following collared bear would be considered in applying protective measures if and when bear denning activity is found within the project area.

Core habitat: Since the 1997 Baseline was established, there has been an increase in core habitat on federal land due to road decommissioning and closure in the Boulder and Pilchuck BMUs as displayed in Table 6. The roads proposed for treatment and put into storage or decommissioned would further reduce open roads, providing additional acres of early and late core habitat in the two BMUs being analyzed (Table 9). This alternative would provide for a status of at least 55 percent core habitat for both BMUs, which are considered desirable for exterior BMUs by the Interagency Grizzly Bear Committee (IGBC 2001).

Table 9. Change in Grizzly Core Habitat on Federal Land in BMUs by Alternative as a Result of Road Decommissioning and Closure.

BMU Name	1997 Baseline		No Action/Current		Preferred Alternative	
	Early Core Acres	Late Core Acres	Early Core Acres	Late Core Acres	Early Core Acres	Late Core Acres
Boulder	13,457	12,174	16,684	15,142	19,308	18,481
Pilchuck	12,618	11,913	14,370	13,580	15,150	14,355

Core habitat is to be considered transitory for closed (stored) roads that have the option to be reopened in the future as management needs change. However, this does not diminish their contribution to core habitat while they are closed.

There would be a short-term (1 to 2 seasons per road segment) increase in human access during road work within the project area. Impacts to grizzly bear could include a temporary displacement of use of the area during the work, typically less than 1 season. However, this potential disturbance is expected to be negligible in comparison to the amount of core habitat gained with these actions.

As a result, adverse effects to grizzly bear and its habitat are not expected to occur. This alternative may affect, and is likely to beneficially affect the grizzly bear by increasing core habitat.

Gray Wolf

There would be no adverse effects to gray wolf due to current lack of wolf occupancy in the South Fork Stillaguamish drainage at this time. Due to a limited prey base, wolves are not currently expected to be present in the project area. It is possible transient wolves may temporarily wander onto the MBS along the Cascade Crest, but they are not expected to occur within the project area due to the current lack of a suitable prey base.

While there has been recent detections of wolf activity on the west side of the Cascades, there has been no current detections in the South Fork of the Stillaguamish drainage. The most recent activity west side of the Cascades was in May 2017 with the capture a single adult male wolf by WDFW in the vicinity of Marblemount, WA. Marblemount is approximately 40-50 km (25 - 30 miles) north of the project area. Presently it remains unclear if this is a single individual or if there are other wolves traveling with this animal. Future coordination between MBS NF and WDFW in April/May 2018 regarding the locations of wolves fit with GPS collars may reveal potential denning behavior and if subsequent temporary restrictions are necessary to protect pups.

Wolves typically breed in February, the breeding female enters a den in late March/early April, and pups are typically born around mid-April (mean partition for ID, MT and WY). The Forest would provide restrictions on activities within 0.25 miles of known gray wolf den sites or rendezvous sites between March 15 and June 30. Activities proposed within 0.25 mile miles of known gray wolf den sites or rendezvous sites are at any time of year would be shared with the Level I Team.

Given the entire 10-15 year estimated project timeline and the current trajectory of wolf recolonization, it remains possible that wolves could utilize the MBS as dispersal habitat, and potentially occupy portions of the MBS as resident packs with possible den sites in the project area.

The project area impacts to gray wolf habitat are is an increase in forage for black-tail deer, a prey item. The project would enhance forage for black-tail deer, with the potential for higher productive success and survival resulting in a local increase in deer population within the South Fork Stillaguamish drainage. This localized increase in the deer population would not alter the deer population sufficiently to provide a substantial increase in the prey base for reproductive habitat for wolves.

There would be a short-term (1 to 2 seasons per road segment) increase in human access during road and thinning work within the project area. Impacts to gray wolf could include a temporary displacement of use of the area during the work, typically less than 1 season. If in 10-15 years a wolf den and/or rendezvous site is located in the project area, the MBS would employ temporary restrictions related to the project (thinning operations, road building, blasting etc.) near den and rendezvous sites. Wolf pups are generally mature enough to move out of a disturbed area (den and rendezvous sites) when they are approximately 5 months old, after September 1st. Although the likelihood of an active den site in the project area is low, the MBS would cease thinning operations and road building within ¼ mile of a known active den site between March 15th and September 1st. New information gained from following collared wolves would also be considered in applying protective measures if and when wolf denning activity is found within the project area.

The roads proposed for treatment and put into storage or decommissioned would further reduce open roads, providing additional acres of security habitat (Table 9). Therefore, the project impacts to forest habitat would not substantially change wolf foraging or denning habitat, or the capability for wolf use of the area. The potential disturbance is expected to be negligible in comparison to the amount of security habitat gained with the road closure actions.

As a result, adverse effects to gray wolf are not expected to occur. This alternative may affect, and is likely to beneficially affect the gray wolf by increasing security habitat and localized forage for ungulate prey base.

6. Consultation Requirements

As a result of the “may affect” determinations above for these species and their designated critical habitat, consultation with the U.S. Fish and Wildlife Service is required.

7. Contributors

Phyllis Reed, Wildlife Biologist, Mt. Baker-Snoqualmie National Forest

Zachary Radmer, Biologist, U.S. Fish and Wildlife Service

8. REFERENCES CITED

- Almack, J.A., W.L. Gaines, P.H. Morrison, J.R. Eby, R.H. Naney, G.F. Wooten, M.C. Snyder, S.H. Fitkin, and E.R. Garcia. 1994. North Cascades Grizzly Bear Ecosystem evaluation: final report. Interagency grizzly bear committee, Denver, Colorado.
- Anderson, P. D. and M.A. Meleason. 2009. Discerning responses of down wood and understory vegetation abundance to riparian buffer width and thinning treatments: an equivalence-inequivalence approach. Canadian J. For. Res. 39: 2470-2485. <http://naldc.nal.usda.gov/download/37291/PDF>
- Andrews, L.S., J.P Perkins, J.A. Thrailkill, N.J. Poage, and J.C. Tappeiner II. 2005. Silvicultural approaches to develop northern spotted owl nest sites, central coast range, Oregon. Western Journal of Applied Forestry. 20(1). http://www.fs.fed.us/pnw/pubs/journals/pnw_2009_hummel001.pdf
- Ares, A., S.D. Berryman, and K.J. Puettmann. 2009. Understory vegetation response to thinning disturbance of varying complexity in coniferous stands. Journal of Applied Vegetation Science. 12(4): 472-487.
- Aubry, Keith B.; Halpern, Charles B.; Peterson, Charles E. 2009. Variable-retention harvest in the Pacific Northwest: A review of short-term findings from the DEMO study. Forest Ecology and Management 258 (2009) 398-408. <http://www.sciencedirect.com/science/article/pii/S0378112709001753>
- Aubry, K.B., K.S. McKelvey, and J.P. Copeland. 2007. Distribution and Broadside Habitat Relations of the Wolverine in the Contiguous United States. Journal of Wildlife Management vol 71, no. 7: 2147-58.

Biological Assessment - South Fork Stillaguamish Project

- John D Bailey, John C Tappeiner, 1998 Effects of thinning on structural development in 40- to 100-year-old Douglas-fir stands in western Oregon. (1997) *Forest Ecology and Management*, 108, (1998) 99-113.
<http://www.sciencedirect.com/science/article/pii/S0378112798002163>
- Bart J. and E. Forsman. 1992. Dependence of northern spotted owls (*Strix occidentalis caurina*) on old-growth forests in the western USA. *Biological Conservation* 1992: 95-100.
- Bissonette, J.A. and Adair, William. 2007. Restoring habitat permeability to roaded landscapes with isometrically-scaled wildlife crossings. *Biological Conservation* 141 (2008) 482-488
<http://www.sciencedirect.com/science/article/pii/S0006320707004235>
- Brown, E.R. 1985. tech. ed. *Management of wildlife and fish habitats in forests of western Oregon and Washington*. Portland, Oregon: USDA Forest Service, Pacific Northwest Region, 2 v. pp. 332.
- Carey, A.; Johnson F. 1995. Small Mammals in Managed, Naturally Young, and Old Growth Forests. *J. Ecological Society of America. Ecological Applications* 5(2):336-352.
www.fs.fed.us/pnw/pubs/journals/pnw_1995_carey002.pdf
- Carey, A.B. 1995. Sciurids in Pacific Northwest managed and old growth forest. *Ecological Applications* 5 (3): 648-661. www.treesearch.fs.fed.us/pubs/6166
- Carey, A.B. 2001. Experimental manipulation of spatial heterogeneity in Douglas-fir forests: effects on squirrels. *Forest Ecology and Management* 152 (2001) 13-30. www.elsevier.com/locate/foreco
- Carey, A.B. 2003. Biocomplexity and restoration of biodiversity in temperate coniferous forest: inducing spatial heterogeneity with variable-density thinning. *Forestry*. 76(2):127-136.
www.fs.fed.us/pnw/pubs/journals/pnw_2003_carey001.pdf
- Carey, Andrew B. 2006. Active and Passive Forest Management for Multiple Values. *Northwestern Naturalist* 87 (1): 18-30. 2006
- Carey, A.B. and S.M. Wilson. 2001. Induced spatial heterogeneity in forest canopies: responses of small mammals. *Journal of Wildlife Management*. 65(4):1014-1027.
www.fs.fed.us/pnw/pubs/journals/pnw_2001_carey002.pdf
- Chambers, C., W.C. McComb, and J.C. Tappeiner II. 1999. Breeding bird responses to three silvicultural treatments in the Oregon coast range. *Ecological Applications*. 9(1): 171-185.
- Chan, Samuel S.; Larson, David J.; Maas-Hebner, Kathleen G.; Emmingham, William H.; Johnston, Stuart R. and Mikowski, Daniel A. 2006. Overstory and understory development in thinned and underplanted Oregon Coast Range Douglas-fir stands. *Can. J. For. Res.* 36: 2696-2711 (2006)
http://www.fs.fed.us/pnw/pubs/journals/pnw_2006_chan001.pdf
- Courtney S.P. and others. 2004. Scientific Evaluation of the Status of the northern spotted owl. Portland, Oregon: Sustainable Ecosystems Institute (SEI).
<http://www.fws.gov/oregonfwo/Species/Data/NorthernSpottedOwl/BarredOwl/Documents/CourtneyEtAl2004.pdf>
- Curtis, Robert O. 2008. True Fir Spacing Trials – 10-Year Results. USDA Forest Service, Pacific Northwest Research Station General Technical Report NNW-GTR-749 April 2008.
http://www.fs.fed.us/pnw/pubs/pnw_gtr749.pdf

Biological Assessment - South Fork Stillaguamish Project

- Davis, L. and K.J. Puettmann. 2009. Initial response of understory vegetation to three alternative thinning treatments. *Journal of Sustainable Forestry*. 28: 904 – 934. <http://www.treeseearch.fs.fed.us/pubs/36182>
- Delaney, D.K. and others. 1999. Effects of helicopter noise on Mexican spotted owls. *J. Wildlife Management* 63(1) pp. 60–76.
- Delaney, D.K., T.G. Grubb. 1999. Activity patterns of nesting Mexican spotted owls. *Condor* 101 pp. 42–49.
- Drew, T.J. ; Flewelling, J.W. 1979. Stand Density Management: An alternative approach and its application to Douglas-fir plantations. *Forest Science* 25:518—532.
- Falxa, Gary A.; Raphael, Martin G., tech. cords. 2016 Northwest Forest Plan-the first 20 years (1994-2013): status and trend of marbled murrelet populations and nesting habitat. Gen. Tech. Rep. PNW-GTR-933. Portland OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 132 p.
- Federal Register. 1996. USDI–Final Designation of Critical habitat for Marbled Murrelet. 61 FR 26255 26320 Washington, DC.
<http://ecos.fws.gov/speciesProfile/profile/displayAllDocuments!fedreg.action;jsessionid=5329FF958807461769BCE24FA6620728?spcode=B08C>
- Federal Register. 2007. USDI–Proposed Rule for spotted owl. Web site: <http://ecos.fws.gov/sevlet/species>
- Forest Ecosystem Management Assessment Team [FEMAT]. 1993. Forest ecosystem management: an ecological, economic, and social assessment. Portland (OR): USDA, USDI [et al.].
- Franklin, Jerry F. and Johnson, K. Norman 2012. A Restoration Framework for Federal Forests in the Pacific Northwest. *Journal of Forestry J.For* __ __ __():000-000 <http://dx.doi.org/10.5849/jof.10-006>
- Franklin, Jerry F. and Johnson, Norman K. 2011 Moist Forest Principles and Prescriptions (emphasizing the creation of diverse early successional ecosystems through variable retention regeneration harvest) Unpublished paper.
- Franklin, Jerry F.; Mitchell, Robert J.; Palik Brian J. 2007 Natural Disturbance and Stand Development Principles for Ecological Forestry. Gen Tech. Rep. NRS-19. USDA, Forest Service Northern Research Station.
<http://www.nrs.fs.fed.us/pubs/3293>
- Franklin; Van Pelt. 2004. *Journal of Forestry*. April/May Volume 102, No. 3. pp. 22–27.
<http://www.ingentaconnect.com/content/saf/jof/2004/00000102/00000003/art00008>
- Fuller, T. K., and L. B. Keith. 1980. Wolf population dynamics and prey relationships in northeastern Alberta. *Journal of Wildlife Management* 44:583-602.
- Fuller, T. K. 1989. Population dynamics of wolves in north-central Minnesota. *Wildlife Monograph* 105. Wildlife Society, Washington, D.C.
- Grubb, T.G., D.K. Delaney, W.W. Bowerman, M.R. Wierda. 2010 Golden Eagle Indifference to Heli-Skiing and Military Helicopters in Northern Utah. *The Journal of Wildlife Management* 4(6):1275- 1285
- GTR-PSW-152. 2005. Ecology and Conservation of the Marbled Murrelet. Albany, CA: Pacific Southwest Research Station. http://www.fs.fed.us/psw/publications/documents/psw_gtr152/psw_gtr152_fm.pdf

Biological Assessment - South Fork Stillaguamish Project

- Hamer, T. E. 1998. Home range size of the northern barred owl and the northern spotted owl in western Washington. M.S. Thesis. Western Washington University, Bellingham, WA. 73 pp.
- Hamer, T.E., D.L. Hayes, C.M. Senger, and E.D. Forsman. 2001. Diets of Northern Barred Owls and Northern Spotted Owls in an Area of Sympatry. *J. Raptor Res.* 35(3):221-227.
- Hamer, T. E., E. D. Forsman, and E. M. Glenn. 2007. Home range attributes and habitat selection of barred owls and spotted owls in an area of sympatry. *The Condor* 109:750-768.
- Hammond, Paul. 2006. Personal communication with Eric Scheuering, cited in USDA fact sheet prepared by Sarah Foltz, Xerces Society for Invertebrate Conservation in 2009, updated with edits by Rob Huff, FS/BLM Conservation Planning Coordinator in June 2011, Portland OR
- Hansen, A.J., S.L. Garman, J.F. Wiegand, D.L. Urban, W.C. McComb, and M.G. Raphael. 1995. Alternative silvicultural regimes in the Pacific Northwest: Simulations of structural and economic effects; *Ecol. Applic* 5:535-554. <http://www.jstor.org/stable/1941965>
- Harrington, C.A., S.D. Roberts, and L.C. Brodie. 2005. Tree and understory responses to variable density thinning in western Washington. In: *Balancing ecosystem values: innovative experiments for sustainable forestry: Proceedings of a conference*, by C.E. Peterson, D.A. Maguire, eds. [Abstract] GTR-635 <http://www.fs.fed.us/pnw/publications/gtr635/index.shtml>
- Hayes, J.P. and others. 1997. Wildlife response to thinning young forests in the Pacific Northwest. *Journal of Forestry*. Vol. 95 pp. 28-33
- Henderson J.A. and others. 1992. Field guide to the forested plant associations of the Mt. Baker-Snoqualmie National Forest. USDA Forest Service Tech. Paper, R6-Ecol-TP-028-91.
- Hinam, Heather Lynn.; St. Clair, Colleen Cassady. 2007 High levels of habitat loss and fragmentation limit reproductive success by reducing home range size and provisioning rates of Northern saw-whet owls. *Biological Conservation* 141 (2008) 524-535 <http://www.sciencedirect.com/science/article/pii/S0006320707004466>
- Holland, Andy. 1980. Switchbacks. The Mountaineers, Seattle Washington. 1980
- Holloway, Gillian L. and Smith, Winston P. 2010 A Meta-Analysis of Forest Age and Structure Effects on Northern Flying Squirrel Densities. *The Journal of Wildlife Management* 75(3):668-674;2011 http://www.fs.fed.us/pnw/pubs/journals/pnw_2011_holloway001.pdf
- Huff, Mark H.; Raphael, Martin G.; Miller, Sherri L.; Nelson, S. Kim; Baldwin, Jim, tech. coords. 2006. Northwest Forest Plan—The first 10 years (1994-2003): status and trends of populations and nesting habitat for the marbled murrelet. Gen. Tech. Rep. PNW-GTR-650. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 149 p. http://www.fs.fed.us/pnw/publications/pnw_gtr720/
- Interagency Grizzly Bear Committee (IGBC). 2001. North Cascades ecosystem grizzly bear habitat assessment. Unpublished draft report. Darrington, WA: Darrington Ranger District files.
- IGBC 2001. North Cascades Grizzly Bear Technical Team DRAFT Meeting Notes 2/6/2001.

Biological Assessment - South Fork Stillaguamish Project

- Ishii, Hiroaki and Ford E. David 2001. The role of epicormic shoot production in maintaining foliage in old *Pseudotsuga menziessi* (Douglas-fir) trees. Canadian Journal of Botany 79: 251-264 (2001)
- Johnson, D. H.; O'Neil T. A. 2001. Wildlife-habitat relationships in Oregon and Washington. Corvallis, OR: Oregon State University Press. pp. 722.
- Johnson, R.E. and K.M. Cassidy. 1997. Terrestrial mammals of Washington State. Location data and predicted distributions. Volume 3 in Washington State Gap Analysis – Final Report. Washington Cooperative Fish and Wildlife Research Unit, University of Washington, Seattle, 304 p.
- Johnson, R.E. 1977. An Historical Analysis of Wolverine Abundance and Distribution in Washington. The Murrelet, Vol. 58, No. 1 (Spring, 1977), pp. 13-16
- Kane, Van R.; Gersonde, Rolf F.; Lutz, James A.; McGaughey Robert J.; Bakker, Johathan D.; and Franklin, Jerry F. 2011. Patch Dynamics and the development of structural and spatial heterogeneity in Pacific Northwest Forests. Can. J. For. Res. 41: 2276-2291 (2011) <http://www.nrcresearchpress.com/doi/abs/10.1139/x11-128>
- Kerr, Andy. 2012. Ecologically Appropriate Restoration Thinning in the Northwest Forest Plan Area a Policy and Technical Analysis. Conservation Northwest; Geos Institute; Klamath-Siskiyou Wildlands Center; Oregon Wild. http://www.oregonwild.org/oregon_forests/old_growth_protection/westside-forests/Kerr%20Andy.%202012.%20Ecologically%20Appropriate%20Restoration%20Thinning%20in%20the%20Northwest%20Forest%20Plan%20Area.pdf
- Kohm, K.A.; Franklin, J.F. 1997. Creating a forestry for the 21st century. Washington D.C: Island Press. pp. 475.
- Krebs, J., E. C. Lofroth, and I. Parfitt. 2007. Multiscale habitat use by wolverines in British Columbia, Canada. Journal of Wildlife Management 71:2180–2192.
- Kuehne, C. and K.J. Puettman. 2008. Natural Regeneration in Thinned Douglas-fir Stands in Western Oregon. Journal of Sustainable Forestry, Vol. 27(3). <http://www.tandfonline.com/toc/wjsf20/27/3>
- Maguire, D.A., C.B. Halpern, and D.L. Phillips. 2007. Changes in Forest Structure Following Variable-Retention Harvests in Douglas-fir Dominated Forests. Forest Ecology and Management, 242(708–726). <http://www.sciencedirect.com/science/article/pii/S0378112707001326>
- Maxwell, W.G.; Ward, F.R. 1976. Photo series for quantifying forest residues in the: coastal Douglas-fir hemlock type, coastal Douglas-fir hardwood type. General Technical Report PNW 51. USDA Forest Service
- McKenney, Daniel W.; Pedlar, John H.; Lawrence, Kevin; Campbell, Kathy and Hutchinson, Michael F. 2007 Potential Impacts of Climate Change on the Distribution of North American Trees. American Institute of Biological Sciences December 2007/Vol. 57 No. 11. 939-948 <http://www.aibs.org/bioscience-press-releases/resources/12-07.pdf>
- McLellan, B.N.; Hovey F.W. 2001. Habitats selected by grizzly bears in multiple use landscapes. Journal of Wildlife Management. Vol. 65(1) pp. 92–99.
- McLellan, B.N.; Shackelton D.M. 1988. Grizzly bears and resource extraction industries: effects of roads on behavior, habitat use and demography. Journal of Applied Ecology Vol. 25 pp. 451–160.

Biological Assessment - South Fork Stillaguamish Project

- McIntosh, A.C.S.; A. Gray, and S.L. Garman. 2009. Canopy structure on forest lands in western Oregon: differences among forest types and stand ages. Gen. Tech. Rep. PNW-GTR-794. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 35 p.
http://www.fs.fed.us/pnw/pubs/pnw_gtr794.pdf
- Mech, L. D. 1970. The wolf. Doubleday, New York. 384pp.
- Mellen-McLean, Kim, Bruce G. Marcot, Janet L. Ohmann, Karen Waddell, Susan A. Livingston, Elizabeth A. Willhite, Bruce B. Hostetler, Catherine Ogden, and Tina Dreisbach. 2012. DecAID, the decayed wood advisor for managing snags, partially dead trees, and down wood for biodiversity in forests of Washington and Oregon. Version 2.20. USDA Forest Service, Pacific Northwest Region and Pacific Northwest Research Station; USDI Fish and Wildlife Service, Oregon State Office; Portland, Oregon.
<http://www.fs.fed.us/r6/nr/wildlife/decaid/index.shtml>
- Nelson, S. K. and A. K. Wilson. 2002. Marbled Murrelet habitat characteristics on state lands in western Oregon. Final Rep., OR Coop. Fish and Wildlife Research Unit, Oregon State Univ., Dept. Fisheries and Wildlife, Corvallis. 151 pp.
- Newsome T.M. et al .2016. Food habits of the world's grey wolves. Mammal Review - need to download citation
- O'Callaghan, Joan. 2012. Remember Redcedar! An Overlooked Species Reveals Its Potential. USDA Pacific Northwest Research Station, US Gov Printing Office:2012 576-417 / 00409 Region No. 10
<http://www.fs.fed.us/pnw/science/scifi147.pdf>
- O'Neil, Thomas A. and others. 2001. Matrixes for wildlife-habitat relationship in Oregon and Washington. (CD-ROM) Northwest Habitat Institute. In: D. H. Johnson and T. A. O'Neil (Manag. Dirs.) Wildlife-habitat relationships in Oregon and Washington. Corvallis, OR: Oregon State University Press.
- ONRC Update. College of Forest Resources, University of Washington
- Poage, N.J., and J.C. Tappeiner. 2002. Long-term patterns of diameter and basal area growth of old-growth Douglas-fir trees in western Oregon. Can. J. For. Res. 32(7):1232-1243
- Pearson, R.R.; Livezey, Kent B. 2007. Spotted owls, barred owls, and late-successional reserves. Lacey WA: U.S. Fish and Wildlife Service. Vol. 41-2. pp. 156-161.
- Peter, David 1993. Subregional ecological assessment for the Mt. Baker-Snoqualmie National Forest, Draft document. Mountlake Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- Peter, David H.; Harrington, Constance A. 2010. Reconstructed old-growth forest stand structure and composition of two stands on the Olympic Peninsula, Washington state. USDA Forest Service, Pacific Northwest Research Station. Res. Pap. PNW-RP-583. http://www.fs.fed.us/pnw/pubs/pnw_rp583.pdf
- Raphael, M.G. and others. 2002. Effects of streamside forest management on the composition and abundance of stream and riparian fauna of the Olympic Peninsula. In: Johnson, A.; Haynes, R. eds. Proceedings of the wood compatibility initiative workshop. Gen.Tech. Rep. PNW-GTR-563. Portland, OR: Pacific Northwest Research Station.

Biological Assessment - South Fork Stillaguamish Project

- Roberts, S. A. and C. A. Harrington. 2008. Individual Tree Growth Response to Variable-density Thinning in Coastal Pacific NW Forests. *Forest Ecology and Management* 255 (2008) 2771-2781
<http://fsweb.edc2.r6.fs.fed.us/nr/sil/documents/harringtonHDS.pdf>
- Rosenberg, Daniel K., Swindle, Keith A., and Anthony, Robert G. 2003. Influence of prey abundance on northern spotted owl reproductive success in western Oregon. *Canadian Journal of Zoology* 81: 1715-1725 (2003)
- Ruggiero, L.F. and others (tech coordinators). 1991. Wildlife and vegetation of unmanaged Douglas-fir forests. General Technical report PNW-GTR-285. Portland, OR: Pacific Northwest Research Station. pp. 533.
www.fs.fed.us/pnw/pubs/gtr285
- Ruggiero, L.F.; Aubry K.B. 1994. The scientific basis for conserving forest carnivores. General Technical Report RM-GTR-254. Fort Collins, CO: Rocky Mountain Forest and Range Experimental Station.
- Smith, Winston P. 2007. Ecology of *Glaucomys sabrinus*: Habitat, Demography, and Community Relations. *Journal of Mammalogy*, 88(4):826-881. 2007. <http://www.bioone.org/doi/ful.10.1664/06-MAMM-S-371R1.1>
- Spies, T.A.; Franklin J.F. 1988. Course woody debris in Douglas-fir forests of western Oregon and Washington. *Journal of Ecology*.
- Steventon, J. Douglas and others 2006. A population-viability-based risk assessment of Marbled Murrelet nesting habitat policy in British Columbia, Canada.
- Swanson, Mark E., Franklin, Jerry F., Beschta, Robert L., Crisafulli, Charles M., DellaSala, Dominick A., Hutto, Richard L., Lindenmayer, David B. and Swanson, Frederick J. 2011. The forgotten stage of forest succession: early-successional ecosystems on forest sites. *The Ecological Society of America Front Ecol Environ* 2011; 9(2): 117-125 www.frontiersinecology.org doi:10.1890/090157 (published online 2 Mar 2010)
- Tappeiner II, J.C. , W.H. Emmingham, and D.E. Hibbs. 2002. Silviculture of Oregon Coast Range Forests. Chapter 7 in *Forest and Stream Management in the Oregon Coast Range*. Eds. S.D. Hobbs, J. P. Hayes, R.L. Johnson, G.H. Reeves, T.A. Spies, J.C. Tappeiner II, and G.E. Wells.
- Thomas, J.W., E.D. Forsman; J.B. Lint; E.C. Meslow; B.R. Noon; and J. Verner. 1990. A conservation strategy for the northern spotted owl: a report of the Interagency Scientific committee to address the conservation of the northern spotted owl. Portland, Oregon. U.S. Department of Agriculture, Forest Service; U.S. Department of Interior, Bureau of Land Management, U.S. Fish and Wildlife Service, National Park Service. 427 pp.
- USDA Forest Service, USDI Bureau of Land Management. 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. Portland, Oregon.
- USDA Forest Service, USDI Bureau of Land Management. 2001. Record of decision and standards and guidelines for amendments to the survey and manage, protection buffer, and other mitigation measure standards and guidelines. Portland, OR.
- USDI Bureau of Land Management, USDA Forest Service. 2003. Draft version 3.0. Survey protocol for survey and manage terrestrial mollusk species. In: *Northwest Forest Plan*. Portland, OR and Vallejo, CA: Pacific Southwest and Pacific Northwest Regions.

Biological Assessment - South Fork Stillaguamish Project

- USDA Forest Service, USDI Bureau of Land Management. 2004. Record of Decision to clarify provisions relating to the aquatic conservation strategy amending resource management plans for 7 Bureau of Land Management Districts and land and resource management plans for 19 national forests within the range of the northern spotted owl. Portland, OR.
- USDA Forest Service, USDI Bureau of Land Management. 2004. Record of decision to remove or modify the survey and manage mitigation measure standards and guidelines in Forest Service and Bureau of Land Management planning documents within the range of the northern spotted owl. Portland, OR.
- USDA Forest Service, 2002. Programmatic Biological Assessment for Forest Management and FWS Biological Opinion. Mountlake, Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. Manual 2670 and 2080. Washington DC.
- USDA Forest Service. 1976. Photo series for quantifying natural forest residues in coastal Douglas-Fir-Hemlock Type, Coastal Douglas-Fir-Hardwood Type. Gen. Tech. Report PNW-51.
- USDA Forest Service. 1980. Photo series for quantifying natural forest residues in common vegetation types of the Pacific Northwest. General Technical Report PNW-105.
- USDA Forest Service. 1985. Management of wildlife and fish habitats of western Oregon and Washington. Portland, OR: USDA Forest Service, Pacific Northwest Region.
- USDA Forest Service. 1990. Mt. Baker-Snoqualmie National Forest land and resource management plan. Seattle, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 1992. Gray Wolf Survey Results unpublished material from the Darrington District files. Mountlake Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 1994. Lower South Fork Stillaguamish River and Canyon Creek Watershed Analysis. Everett, Washington: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 1995. South Fork Upper Stillaguamish Watershed Analysis. Everett, Washington: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 1995. Forest Wide Access and Travel Management Plan. Mountlake Terrace, WA. Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 1997. Grizzly bear recovery—North Cascades ecosystem. File code 2600, dated August 12, 1997. Memo to the Regional Forester, Pacific Northwest Region, from the Forest Supervisors of the Okanogan, Wenatchee, and Mt. Baker-Snoqualmie National Forests. Mountlake Terrace, WA Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 1998. Grizzly Bear Core Area Analysis Summary. Unpublished Draft. USDA, Forest Service. Mountlake Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 2001. Forest-wide Late Successional Reserve Assessment. Mountlake Terrace, WA: Mt. Baker-Snoqualmie National Forest. p. 26.
- USDA Forest Service. 2002. Programmatic biological assessment for forest management on the Mt. Baker-Snoqualmie National Forest. Mountlake Terrace, WA: Mt. Baker-Snoqualmie National Forest.

Biological Assessment - South Fork Stillaguamish Project

- USDA Forest Service. 1997. Grizzly bear recovery—North Cascades ecosystem. File code 2600, dated August 12, 1997. Memo to the Regional Forester, Pacific Northwest Region, from the Forest Supervisors of the Okanogan, Wenatchee, and Mt. Baker-Snoqualmie National Forests. Mountlake Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 1998. Grizzly Bear Core Area Analysis Summary. Unpublished Draft. USDA, Forest Service. Mountlake, Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 2001. Forest-wide late successional reserve assessment. Mountlake Terrace, WA: Mt. Baker Snoqualmie National Forest. p. 26.
- USDA Forest Service. 2002. Programmatic biological assessment for forest management on the Mt. Baker-Snoqualmie National Forest. Mountlake Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 2003. Mt. Baker-Snoqualmie National Forest Roads Analysis. Unpublished document and database. Mountlake, Terrace, WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 2005. Internal document. Woody biomass utilization, grant program status report. Madison, WI.
- USDA Forest Service. 2005: 2004 Science Accomplishments of the Pacific Northwest Research Station. Portland, Oregon, report and CD-ROM
- USDA Forest Service. 2011b. Forest-wide MIS Assessment Everett WA: Mt. Baker-Snoqualmie National Forest.
- USDA Forest Service. 2015. Regional Forester's sensitive animal species list. Portland, OR: USDA Forest Service, Pacific Northwest Region. <https://www.fs.fed.us/r6/sfpnw/issssp/agency-policy/>
- USDA Forest Service. Forest vegetation simulator version 6.21, Westside Cascades.
- USDI Bureau of Land Management, USDA Forest Service. 2003. Draft version 3.0. Survey protocol for survey and manage terrestrial mollusk species. In: Northwest Forest Plan. Portland, OR and Vallejo, CA: Pacific Southwest and Pacific Northwest Regions.
- USDI Fish and Wildlife Service 1990. Determination of threatened status for the northern spotted owl final rule. June 26, 1990 Federal Register 90 FR 26114.
- USDI Fish and Wildlife Service. 1992. Determination of Critical Habitat for the Northern Spotted Owl. Final rule. January 15, 1992 Federal Register 57 FR 1796.
- USDI Fish and Wildlife Service. 1992. Determination of threatened status for the Washington, Oregon, and California population of the marbled murrelet. Final rule. October 01, 1992 Federal Register 57 FR 45328.
- USDI Fish and Wildlife Service. 1992. Recovery Plan for the Northern spotted Owl. USDI Fish and Wildlife Service. 1993. Grizzly Bear Recovery Plan. Missoula, MT.; Portland, OR: pp. 322.
- USDI Fish and Wildlife Service. 1993. Grizzly Bear Recovery Plan. Missoula, MT.
- USDI Fish and Wildlife Service. 1996. Final designation of critical habitat for the marbled Murrelet. Final Rule. May 26, 1996 Federal Register 61 FR 26255.

Biological Assessment - South Fork Stillaguamish Project

- USDI Fish and Wildlife Service. 1997. Grizzly Bear recovery plan supplement: North Cascades ecosystem recovery plan. Missoula, MT: pp. 29.
- USDI Fish and Wildlife Service. 1997. Recovery Plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon, and California. Portland, Oregon: pp. 203.
- USDI Fish and Wildlife Service. 2000. Final Rule to list the contiguous U.S. District population segment of the Canada lynx. Final rule. March 24, 2000 Federal Register 65 FR 16052.
- USDI Fish and Wildlife Service. 2002. Biological Opinion of the Effects of Mt. Baker-Snoqualmie National Forest Program of Activities for 2003–2007. FWS Reference Number 1–3-02-F-1583. Lacey, WA.
- USDI Fish and Wildlife Service. 2008. Revised designation of critical habitat for the northern spotted owl. Final rule. August 13, 2008, Federal Register 73 FR 47326.
- USDI Fish and Wildlife Service. 2011. Revised critical habitat for the marbled murrelet. Final rule. October 5, 2011, Federal Register 76 FR 61599.
- USDI Fish and Wildlife Service. 2011. Report on Marbled Murrelet Recovery Implementation Team Meeting and Stakeholder Workshop.
- USDI Fish and Wildlife Service. 2011. Revised Recovery Plan for the Northern Spotted Owl (*Strix occidentalis caurina*). U.S. Fish and Wildlife Service, Portland, Oregon. xvi + 258 pp.
<http://www.fws.gov/oregonfwo/Species/Data/NorthernSpottedOwl/Recovery/Library/Documents/RevisedNSORecPlan2011.pdf>
- USDI Fish and Wildlife Service. 2012. Revised designation of critical habitat for the northern spotted owl. Proposed rule. May 8, 2012, Federal Register 77 FR 27010.
- USDI Fish and Wildlife Service. 2012. Marbled Murrelet Nesting Season and Analytical Framework for Section 7 Consultation in Washington. U. S. Fish and Wildlife Service Washington Fish and Wildlife Office (WFWO) Lacey, Washington. June 20, 2012.
- USDI Fish and Wildlife Service 2013, Programmatic Biological Opinion for Aquatic Restoration Actives in the States of Oregon, Washington, and portions of California, Idaho and Nevada (ARBO II) FWS reference number 01EOFW00-2013-F-0090.
- Waller, J.S.; Servheen C. 2005. Effects of transportation infrastructure on grizzly bears in northwestern Montana. *Journal of Wildlife Management*. 69:985-1000.
- Walter, S.C. and C.C. Maguire. 2004. Conifer Response to Three Silvicultural Treatments in the Oregon Coast Foothills. *Can. J. For. Res.* 34: 1967–1978.
- Washington State Department of Natural Resources. Northern Spotted Owl Habitat Effectiveness Monitoring. PDF http://www.dnr.wa.gov/Publications/lm_hcp_nso_effectiveness_monitoring.pdf
- Washington Department of Fish and Wildlife Web site. Species of Concern List including species listed as State endangered, State threatened, State sensitive, or State candidate, as well as species listed or proposed for listing by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service
<http://wdfw.wa.gov/wlm/diversty/soc/concern.htm>

Biological Assessment - South Fork Stillaguamish Project

- Washington Department of Fish and Wildlife. 2011. Wolf Conservation and Management Plan. Report.
<https://wdfw.wa.gov/publications/00001/>
- Washington Department of Fish and Wildlife. 2016. Wolf Conservation and Management 2016 Annual Report.
<http://wdfw.wa.gov/publications/01895/>
- Weigl, Peter D. 2007 The Northern Flying Squirrel (*Glaucomys sabrinus*): A Conservation Challenge. *Journal of Mammalogy* 88(4):897-907. 2007
- Wiles, G. J., H. L. Allen, and G. E. Hayes. 2011. Wolf conservation and management plan for Washington. Washington Department of Fish and Wildlife, Olympia, WA 297 pp
http://wdfw.wa.gov/conservation/gray_wolf/
- Wilson, S.M. and A.B. Carey. 2000. Legacy retention versus thinning: influences on small mammals. *Northwest Science*. Vol. 74(2) pp. 131-145.
- Worthington, N.P. 1963. Thirteen Years of Thinning in a Douglas-fir Woodland. Research Note PNW-8. USDA Forest Service, Portland, OR.
- Worthington, N.P. 1966. Response to Thinning 60 Year Old Douglas-fir. Research Note PNW-35. USDA Forest Service, Portland, OR.
- Yerkes, V.P. 1960. Growth After Thinning 110 Year Old Douglas-fir. Research Note 189. USDA Forest Service. Portland, OR.
- Zharikov, Yuri; Lank, David B.; and Cooke, Fred 2007. Influence of landscape pattern on breeding distribution and success in a threatened Alcid, the marbled Murrelet: model transferability and management implications. *Journal of Applied Ecology* 2007 44, 748-759
<http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2664.2007.01319.x/abstract>